

**WO9949017**

Publication Title:

**MUTATIONS RESPONSIBLE FOR ATTENUATION IN MEASLES VIRUS OR  
HUMAN RESPIRATORY SYNCYTIAL VIRUS SUBGROUP B**

Abstract:

Abstract of WO9949017

Isolated, recombinantly-generated, attenuated measles viruses and respiratory syncytial subgroup B viruses having defined attenuating mutations are described. Vaccines are formulated comprising such viruses and a physiologically acceptable carrier. The vaccines are used for immunizing an individual to induce protection against measles virus or respiratory syncytial subgroup B virus.

Data supplied from the esp@cenet database - Worldwide

-----  
Courtesy of <http://v3.espacenet.com>

*This Patent PDF Generated by Patent Fetcher(TM), a service of Stroke of Color, Inc.*

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : C12N 7/04, A61K 39/165		A2	(11) International Publication Number: <b>WO 99/49017</b>
			(43) International Publication Date: 30 September 1999 (30.09.99)
(21) International Application Number: PCT/US99/06225 (22) International Filing Date: 22 March 1999 (22.03.99) (30) Priority Data: 60/079,466 26 March 1998 (26.03.98) US (71) Applicant (for all designated States except US): AMERICAN CYANAMID COMPANY [US/US]; Five Giralda Farms, Madison, NJ 07940 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): UDEM, Stephen, A. [US/US]; Apartment 6F/G, 155 West 70th Street, New York, NY 10023 (US). SIDHU, Mohinderjit, S. [US/US]; 35 Lowell Drive, New City, NY 10956 (US). RANDOLPH, Valerie, B. [US/US]; 535 Pine Brook Road, Lincoln Park, NJ 07035 (US). BUONAGURIO, Deborah, A. [US/US]; 60 Parkway Drive, Rye, NY 10580 (US). (74) Agents: GORDON, Alan, M.; American Home Products Corporation, Patent Law Dept. - 2B2, One Campus Drive, Parsippany, NJ 07054 (US) et al.		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  Published Without international search report and to be republished upon receipt of that report.	
(54) Title: MUTATIONS RESPONSIBLE FOR ATTENUATION IN MEASLES VIRUS OR HUMAN RESPIRATORY SYNCYTIAL VIRUS SUBGROUP B			
(57) Abstract <p>Isolated, recombinantly-generated, attenuated measles viruses and respiratory syncytial subgroup B viruses having defined attenuating mutations are described. Vaccines are formulated comprising such viruses and a physiologically acceptable carrier. The vaccines are used for immunizing an individual to induce protection against measles virus or respiratory syncytial subgroup B virus.</p>			
<p>3A A2 B1 2B 2B33F 2B33F TS+ 18537</p> <p>← N-P-M-SH ← P-M-SH ← M-SH ← SH</p>			

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

MUTATIONS RESPONSIBLE FOR ATTENUATION IN MEASLES VIRUS  
OR HUMAN RESPIRATORY SYNCYTIAL VIRUS SUBGROUP B

Field Of The Invention

5

This invention relates to isolated, recombinantly-generated, attenuated measles virus or human respiratory syncytial virus subgroup B having specified attenuating mutations. This invention was made with Government support under a grant awarded by the Public Health Service. The Government has certain rights in the invention.

10

Background Of The Invention

15

Enveloped, negative-sense, single stranded RNA viruses are uniquely organized and expressed. The genomic RNA of negative-sense, single stranded viruses serves two template functions in the context of a nucleocapsid: as a template for the synthesis of messenger RNAs (mRNAs) and as a template for the synthesis of the antigenome (+) strand. Negative-sense, single stranded RNA viruses encode and package their own RNA dependent RNA Polymerase. Messenger RNAs are only synthesized once the nucleocapsid has entered the cytoplasm of the infected cell. Viral replication occurs after synthesis of the mRNAs and requires the continuous synthesis of viral proteins. The newly synthesized antigenome (+) strand serves as the template for generating further copies of the (-) strand genomic RNA.

20

25

30

35

The polymerase complex actuates and achieves transcription and replication by engaging the cis-acting signals at the 3' end of the genome, in particular, the promoter region. Viral genes are then



- 2 -

transcribed from the genome template unidirectionally from its 3' to its 5' end. There is always less mRNA made from the downstream genes (e.g., the polymerase gene (L)) relative to their upstream neighbors (i.e., the nucleoprotein gene (N)). Therefore, there is always a gradient of mRNA abundance according to the position of the genes relative to the 3'-end of the genome.

Based on the revised reclassification in 1993 by the International Committee on the Taxonomy of Viruses, an Order, designated Mononegavirales, has been established. This Order contains three families of enveloped viruses with single stranded, nonsegmented RNA genomes of minus polarity (negative-sense). These families are the Paramyxoviridae, Rhabdoviridae and Filoviridae. The family Paramyxoviridae has been further divided into two subfamilies, Paramyxovirinae and Pneumovirinae. The subfamily Paramyxovirinae contains three genera, *Paramyxovirus*, *Rubulavirus* and *Morbillivirus*. The subfamily Pneumovirinae contains the genus *Pneumovirus*.

The new classification is based upon morphological criteria, the organization of the viral genome, biological activities and the sequence relatedness of the genes and gene products. The morphological distinguishing feature among enveloped viruses for the subfamily Paramyxovirinae is the size and shape of the nucleocapsids (diameter 18nm, 1nm in length, pitch of 5.5 nm), which have a left-handed helical symmetry. The biological criteria are: 1) antigenic cross-reactivity between members of a genus, and 2) the presence of neuraminidase activity in the genera *Paramyxovirus*, *Rubulavirus* and its absence in genus *Morbillivirus*. In addition, variations in the coding potential of the P gene are considered, as is the presence of an extra gene (SH) in Rubulaviruses.

- 3 -

Pneumoviruses can be distinguished from Paramyxovirinae morphologically because they contain narrow nucleocapsids. In addition, pneumoviruses have major differences in the number of protein-encoding  
5 cistrons (10 in pneumoviruses versus 6 in Paramyxovirinae) and an attachment protein (G) that is very different from that of Paramyxovirinae. Although the paramyxoviruses and pneumoviruses have six proteins that appear to correspond in function (N, P, M, G/H/HN,  
10 F and L), only the latter two proteins exhibit significant sequence relatedness between the two subfamilies. Several pneumoviral proteins lack counterparts in most of the paramyxoviruses, namely the nonstructural proteins NS1 and NS2, the small  
15 hydrophobic protein SH, and a second protein M2. Some paramyxoviral proteins, namely C and V, lack counterparts in pneumoviruses. However, the basic genomic organization of pneumoviruses and paramyxoviruses is the same. The same is true of  
20 rhabdoviruses and filoviruses. Table 1 presents the current taxonomical classification of these viruses, together with examples of each genus.

Table 1

25 Classification of Nonsegmented, negative-sense, single stranded RNA Viruses of the Order Mononegavirales  
Family Paramyxoviridae

Subfamily Paramyxovirinae

Genus Paramyxovirus

30 Sendai virus (mouse parainfluenza virus type 1)

Human parainfluenza virus (PIV) types 1 and 3

Bovine parainfluenza virus (BPV) type 3

35 Genus Rubulavirus

- 4 -

- Simian virus 5 (SV) (Canine  
parainfluenza virus type 2)  
Mumps virus  
Newcastle disease virus (NDV) (avian  
Paramyxovirus 1)  
Human parainfluenza virus types 2, 4a  
and 4b
- Genus *Morbillivirus*  
Measles virus (MV)  
Dolphin Morbillivirus  
Canine distemper virus (CDV)  
Peste-des-petits-ruminants virus  
Phocine distemper virus  
Rinderpest virus
- Subfamily Pneumovirinae  
Genus *Pneumovirus*  
Human respiratory syncytial virus (RSV)  
Bovine respiratory syncytial virus  
Pneumonia virus of mice  
Turkey rhinotracheitis virus
- Family Rhabdoviridae  
Genus *Lyssavirus*  
Rabies virus  
Genus *Vesiculovirus*  
Vesicular stomatitis virus  
Genus *Ephemerovirus*  
Bovine ephemeral fever virus
- Family Filoviridae  
Genus *Filovirus*  
Marburg virus

For many of these viruses, no vaccines of any  
kind are available. Thus, there is a need to develop  
vaccines against such human and animal pathogens. Such  
vaccines would have to elicit a protective immune

- 5 -

5 response in the recipient. The qualitative and quantitative features of such a favorable response are extrapolated from those seen in survivors of natural virus infection, who, in general, are protected from reinfection by the same or highly related viruses for some significant duration thereafter.

10 A variety of approaches can be considered in seeking to develop such vaccines, including the use of: (1) purified individual viral protein vaccines (subunit vaccines); (2) inactivated whole virus preparations; and (3) live, attenuated viruses.

15 Subunit vaccines have the desirable feature of being pure, definable and relatively easily produced in abundance by various means, including recombinant DNA expression methods. To date, with the notable exception of hepatitis B surface antigen, viral subunit vaccines have generally only elicited short-lived and/or inadequate immunity, particularly in naive recipients.

20 Formalin inactivated whole virus preparations of polio (IPV) and hepatitis A have proven safe and efficacious. In contrast, immunization with similarly inactivated whole viruses such as respiratory syncytial virus and measles virus vaccines elicited unfavorable immune responses and/or response profiles which predisposed vaccinees to exaggerated or aberrant disease when subsequently confronted with the natural or "wild-type" virus.

30 Early attempts (1966) to vaccinate young children used a parenterally administered formalin-inactivated RSV vaccine. Unfortunately, several field trials of this vaccine revealed serious adverse reactions -- the development of a severe illness with unusual features following subsequent natural infection with RSV (Bibliography entries 1,2). It has been

35

- 6 -

suggested that this formalinized RSV antigen elicited an abnormal or unbalanced immune response profile, predisposing the vaccinee to RSV disease (3,4).

Thereafter, live, attenuated RSV vaccine candidates were generated by cold passage or chemical mutagenesis. These RSV strains were found to have reduced virulence in seropositive adults.

Unfortunately, they proved either over or under-attenuated when given to seronegative infants; in some cases, they also were found to lack genetic stability (5,6). Another vaccination approach using parenteral administration of live virus was ineffective and efforts along this line were discontinued (7).

Notably, these live RSV vaccines were never associated with disease enhancement as observed with the formalin-inactivated RSV vaccine described above. Currently, there are no RSV vaccines approved for administration to humans, although clinical trials are now in progress with cold-passaged, chemically mutagenized strains of RSV designated A2 and B-1.

Appropriately attenuated live derivatives of wild-type viruses offer a distinct advantage as vaccine candidates. As live, replicating agents, they initiate infection in recipients during which viral gene products are expressed, processed and presented in the context of the vaccinee's specific MHC class I and II molecules, eliciting humoral and cell-mediated immune responses, as well as the coordinate cytokine and chemokine patterns, which parallel the protective immune profile of survivors of natural infection.

This favorable immune response pattern is contrasted with the delimited responses elicited by inactivated or subunit vaccines, which typically are largely restricted to the humoral immune surveillance arm. Further, the immune response profile elicited by

- 7 -

5 some formalin inactivated whole virus vaccines, e.g.,  
measles and respiratory syncytial virus vaccines  
developed in the 1960's, have not only failed to  
provide sustained protection, but in fact have led to a  
predisposition to aberrant, exaggerated, and even fatal  
illness, when the vaccine recipient later confronted  
the wild-type virus.

10 While live, attenuated viruses have highly  
desirable characteristics as vaccine candidates, they  
have proven to be difficult to develop. The crux of  
the difficulty lies in the need to isolate a derivative  
of the wild-type virus which has lost its disease-  
producing potential (i.e., virulence), while retaining  
sufficient replication competence to infect the  
15 recipient and elicit the desired immune response  
profile in adequate abundance.

Historically, this delicate balance between  
virulence and attenuation has been achieved by serial  
passage of a wild-type viral isolate through different  
20 host tissues or cells under varying growth conditions  
(such as temperature). This process presumably favors  
the growth of viral variants (mutants), some of which  
have the favorable characteristic of attenuation.  
Occasionally, further attenuation is achieved through  
25 chemical mutagenesis as well.

This propagation/passage scheme typically  
leads to the emergence of virus derivatives which are  
temperature sensitive, cold-adapted and/or altered in  
their host range -- one or all of which are changes  
30 from the wild-type, disease-causing viruses -- i.e.,  
changes that may be associated with attenuation.

Several live virus vaccines, including those  
for the prevention of measles and mumps (which are  
paramyxoviruses), and for protection against polio and  
35 rubella (which are positive strand RNA viruses), have

- 8 -

been generated by this approach and provide the  
mainstay of current childhood immunization regimens  
throughout the world.

5           Nevertheless, this means for generating  
attenuated live virus vaccine candidates is lengthy  
and, at best, unpredictable, relying largely on the  
selective outgrowth of those randomly occurring genomic  
mutants with desirable attenuation characteristics.  
10       The resulting viruses may have the desired phenotype *in*  
*vitro*, and even appear to be attenuated in animal  
models. However, all too often they remain either  
under- or overattenuated in the human or animal host  
for whom they are intended as vaccine candidates.

15           Even as to current vaccines in use, there is  
still a need for more efficacious vaccines. For  
example, the current measles vaccines provide  
reasonably good protection. However, recent measles  
epidemics suggest deficiencies in the efficacy of  
current vaccines. Despite maternal immunization, high  
20       rates of acute measles infection have occurred in  
children under age one, reflecting the vaccines'  
inability to induce anti-measles antibody levels  
comparable to those developed following wild-type  
measles infection (8,9,10). As a result, vaccine-  
25       immunized mothers are less able to provide their  
infants with sufficient transplacentally-derived  
passive antibodies to protect the newborns beyond the  
first few months of life.

30           Acute measles infections in previously  
immunized adolescents and young adults point to an  
additional problem. These secondary vaccine failures  
indicate limitations in the current vaccines' ability  
to induce and maintain antiviral protection that is  
both abundant and long-lived (11,12,13). Recently, yet  
35       another potential problem was revealed. The

- 9 -

hemagglutinin protein of wild-type measles isolated over the past 15 years has shown a progressively increasing distance from the vaccine strains (14). This "antigenic drift" raises legitimate concerns that the vaccine strains may not contain the ideal antigenic repertoire needed to provide optimal protection. Thus, there is a need for improved vaccines.

Rational vaccine design would be assisted by a better understanding of these viruses, in particular, by the identification of the virally encoded determinants of virulence as well as those genomic changes which are responsible for attenuation.

Previously, in U.S. provisional application 60/026,823 and International application PCT/US97/16718, both of which are hereby incorporated by reference, the generation and isolation of recombinantly-generated, attenuated, nonsegmented, negative-sense, single stranded RNA viruses of the Order Mononegavirales having at least one attenuating mutation in the 3' genomic promoter region and having at least one attenuating mutation in the RNA polymerase gene was disclosed. Identification of attenuating changes in other regions of the genomes of these viruses would further assist rational vaccine design.

#### Summary Of The Invention

Accordingly, it is an object of this invention to identify additional regions of the genomes of measles virus and human respiratory syncytial virus subgroup B where mutations result in attenuation of those viruses.

It is a further object of this invention to produce recombinantly-generated viruses which



- 10 -

incorporate such attenuating mutations in their genomes.

It is still a further object of this invention to formulate vaccines containing such attenuated viruses.

These and other objects of the invention as discussed below are achieved by the generation and isolation of recombinantly-generated, attenuated, measles virus or human respiratory syncytial virus subgroup B having specified attenuating mutations.

In the case of measles virus, one or more attenuating mutations are selected from the group consisting of: (1) for the N gene, nucleotide changes which produce changes in an amino acid selected from the group consisting of residues 129 (glutamine → lysine), 148 (glutamic acid → glycine) and 479 (serine → threonine); (2) for the P gene, nucleotide changes which produce changes in an amino acid selected from the group consisting of residues 225 (glutamic acid → glycine), 275 (cysteine → tyrosine) and 439 (leucine → proline); (3) for the C gene, nucleotide changes which produce changes in an amino acid selected from the group consisting of residues 73 (alanine → valine), 104 (methionine → threonine) and 134 (serine → tyrosine); and (4) for the F gene-end signal (the cis-acting transcription termination signal), the change at nucleotide 7243 (T → C), where these nucleotides, as well as others delineated in this application (unless stated otherwise), are presented in positive strand, antigenomic, that is, message (coding) sense.

In the case of human respiratory syncytial virus subgroup B, there is an attenuating mutation in the M gene-end signal (the cis-acting transcription

- 11 -

termination signal) at nucleotide 4199 (T → C), where these nucleotides are presented in positive strand, antigenomic, that is, message (coding) sense.

5 In another embodiment of this invention, these attenuated measles or human respiratory syncytial subgroup B viruses are used to prepare vaccines which elicit a protective immune response against the wild-type form of each virus.

10 In yet another embodiment of this invention, an isolated, positive strand, antigenomic message sense nucleic acid molecule (or an isolated, negative strand genomic sense nucleic acid molecule) having the complete viral nucleotide sequence (whether of wild-type virus or virus attenuated by non-recombinant  
15 means) is manipulated by introducing one or more of the attenuating mutations described in this application to generate an isolated, recombinantly-generated attenuated measles or human respiratory syncytial subgroup B virus. Each attenuated virus is then used  
20 to prepare vaccines which elicit a protective immune response against the wild-type form of each virus.

#### Brief Description Of The Figures

25 Figure 1 depicts the passage history of the Edmonston measles virus (15). The abbreviations have the following meanings: HK - human kidney; HA - human amnion; CE(am) - chick embryo; CEF - chick embryo fibroblast; DK - dog kidney; WI-38 - human diploid  
30 cells; SK - sheep kidney; \* - plaque cloning. The number following each abbreviation represents the number of passages.

35 Figure 2 depicts a map of the measles virus genome showing putative cis-acting regulatory elements at and near the genome and antigenome termini. Top - a

- 12 -

schematic map of the measles virus genome, beginning at the 3' end with 52 nucleotides of leader sequence (l) and ending at the 5' terminus with 37 nucleotides of trailer sequence (t). Gene boundaries are denoted by vertical bars; below each gene is the number of  
5 cistronic nucleotides. Bottom - an expanded schematic view of the 3' extended genomic promoter regions of genome and antigenome, showing the position and sequence of the two highly conserved domains, A and B.  
10 The intervening intergenic trinucleotide is denoted as well. Nascent 5' RNAs encompassing the A' to B' regions are presumed to contain the regulatory sequence at which the N protein encapsidation initiates.

Figure 3 depicts a genetic map of the RSV  
15 subgroup B wild-type strains designated 2B and 18537 (top portion), the intergenic sequences of those strains (middle portion) and the 68 nucleotide overlap between the M2 and L genes (bottom portion). The RSV 2B strain has six fewer nucleotides in the G gene,  
20 encoding two fewer amino acid residues in the G protein, as compared to the 18537 strain. The 2B strain has 145 nucleotides in the 5' trailer region, as compared to 149 nucleotides in the 18537 strain. The 2B strain has one more nucleotide in each of the NS-1,  
25 NS-2 and N genes, and one fewer nucleotide in each of the M and F genes, as compared to the 18537 strain.

Figure 4 depicts a Northern blot analysis of poly (A)+ RNA isolated from Vero cells infected with RSV subgroup A and B viruses. A 1.5 hour  
30 autoradiograph of the blot is shown. Lanes 1-2 contain RNA isolated from cells infected with RSV subgroup A strains (lane 1, 3A; lane 2, A2). Lanes 3-7 contain RNA isolated from cells infected with RSV subgroup B strains: lane 3, B1; lane 4, 2B; lane 5, 2B33F; lane  
35 6, 2B33F TS(+); lane 7, 18537. Monocistronic M gene

- 13 -

and bicistronic M:SH gene transcripts are indicated by arrows.

Figure 5 depicts a ribonuclease protection assay of poly (A)+ RNA extracted from Vero cells infected with RSV subgroup B wild-type 2B, mutant 2B33F, and 2B33F TS(+) revertant viruses to assess the ratio of monocistronic M and SH mRNAs to bicistronic M:SH transcripts for each virus. A 3 hour autoradiograph of the gel is shown. Protected probe fragments are indicated by arrows. Radiolabelled RNA markers (M) were included as size standards: Lane 1, yeast RNA minus RNase; lane 2, yeast RNA plus RNase; lane 3, 2B RNA plus RNase; lane 4, 2B33F RNA plus RNase; lane 5, 2B33F TS+ RNA plus RNase; lane 6, yeast RNA plus RNase; lane 7, yeast RNA minus RNase. RSV 2B-specific probe was used in lanes 1-3 and 2B33F-specific probe was used in lanes 4-7.

Figure 6 depicts a Northern blot analysis of poly (A)+ RNA isolated from Vero cells infected with RSV subgroup A and B viruses. A 1.5 hour autoradiograph of the blot is shown. Lanes 1-2 contain RNA isolated from cells infected with RSV subgroup A strains (lane 1, 3A; lane 2, A2). Lanes 3-7 contain RNA isolated from cells infected with RSV subgroup B strains (lane 3, B1; lane 4, 2B; lane 5, 2B33F; lane 6, 2B33F TS(+); lane 7, 18537). Monocistronic SH gene and bicistronic M:SH gene transcripts are indicated by arrows.

#### Detailed Description Of The Invention

Transcription and replication of negative-sense, single stranded RNA viral genomes are achieved through the enzymatic activity of a multimeric protein

- 14 -

acting on the ribonucleoprotein core (nucleocapsid). Naked genomic RNA cannot serve as a template. Instead, these genomic sequences are recognized only when they are entirely encapsidated by the N protein into the nucleocapsid structure. It is only in that context that the genomic and antigenomic terminal promoter sequences are recognized to initiate the transcription or replication pathways.

All paramyxoviruses require the two viral proteins, L and P, for these polymerase pathways to proceed. The pneumoviruses, including RSV, also require the transcription elongation factor, M2, for the transcriptional pathway to proceed efficiently. Additional cofactors may also play a role, including perhaps the virus-encoded NS1 and NS2 proteins, as well as perhaps host-cell encoded proteins.

However, considerable evidence indicates that it is the L protein which performs most, if not all, the enzymatic processes associated with transcription and replication, including initiation, and termination of ribonucleotide polymerization, capping and polyadenylation of mRNA transcripts, methylation and perhaps specific phosphorylation of P proteins. The L protein's central role in genomic transcription and replication is supported by its large size, sensitivity to mutations, and its catalytic level of abundance in the transcriptionally active viral complex (16).

These considerations led to the proposal that L proteins consist of a linear array of domains whose concatenated structure integrates discrete functions (17). Indeed, three such delimited, discrete elements within the negative-sense virus L protein have been identified based on their relatedness to defined functional domains of other well-characterized proteins. These include: (1) a putative RNA template

- 15 -

recognition and/or phosphodiester bond formation domain; (2) an RNA binding element; and (3) an ATP binding domain. All prior studies of L proteins of nonsegmented negative-sense, single stranded RNA viruses have revealed these putative functional elements (17).

Without being bound by the following, it is reasonable to presume that these non-protein coding, promoter and other cis-acting genomic regulatory domains are important determinants of the efficiency with which transcription and replication by measles virus (MV) and other viruses of the Order Mononegavirales are actualized, in association with the L protein, and that they may therefore be virulence determinants for these viruses as well.

In summary, the invention is believed to encompass a set of changes in several measles virus genes and one cis-acting regulatory domain, and one change in an RSV subgroup B cis-acting regulatory domain, which result in attenuation of each virus while retaining sufficient ability of the virus to replicate. Therefore, as part of a rational vaccine design, such mutations are introduced to provide the desired balance of replication efficiency and immunogenicity: so that the virus vaccine is no longer able to produce disease, yet retains its capacity to infect the vaccinee's cells, to express sufficiently abundant gene products to elicit the full spectrum and profile of desirable immune responses, and to reproduce and disseminate sufficiently to maximize the abundance of the immune response elicited.

Animal studies have demonstrated a decrease in viral replication sufficient to avoid illness but adequate to elicit the desired immune response. This likely represents a decrease in transcription, a

- 16 -

decrease in gene expression of virally encoded proteins, and/or a decrease in antisense templates and, therefore, the production of fewer new genomes. The resulting attenuated viruses are significantly less virulent than the wild-type.

The attenuating mutations described herein may be introduced into viral strains by two methods:

(1) Conventional means such as chemical mutagenesis during virus growth in cell cultures to which a chemical mutagen has been added, selection of virus that has been subjected to passage at suboptimal temperature in order to select temperature sensitive and/or cold adapted mutations, identification of mutant virus that produce small plaques in cell culture, and passage through heterologous hosts to select for host range mutations. These viruses are then screened for attenuation of their biological activity in an animal model. Attenuated viruses are subjected to nucleotide sequencing of their coding and intergenic regions to locate the sites of attenuating mutations. Once this has been done, method (2) is then carried out.

(2) A preferred means of introducing attenuating mutations comprises making predetermined mutations using site-directed mutagenesis. These mutations are identified either by method (1) or by reference to closely-related viruses whose attenuating mutations are already known. One or more mutations as defined herein are introduced into measles virus or RSV subgroup B strains. Cumulative effects of different combinations of coding and non-coding changes can also be assessed.

The mutations to the N, P and/or C genes and/or the F gene-end signal of measles virus, or to the M gene-end signal of RSV subgroup B are introduced by standard recombinant DNA methods into a DNA copy of

- 17 -

the viral genome. This may be a wild-type or a modified viral genome background (such as viruses modified by method (1)), thereby generating a new virus. Infectious clones or particles containing these attenuating mutations are generated using the cDNA "rescue" system, which has been applied to a variety of viruses, including Sendai virus (18); measles virus (19); respiratory syncytial virus (20); PIV-3 (21); rabies (22); vesicular stomatitis virus (VSV) (15); and rinderpest virus (23); these references are hereby incorporated by reference. See, for measles virus rescue, published International patent application WO 97/06270, designating the United States (24); for RSV rescue, published International patent application WO 97/12032, designating the United States (25); these applications are hereby incorporated by reference.

Briefly, all Mononegavirales rescue systems can be summarized as follows: Each requires a cloned DNA equivalent of the entire viral genome placed between a suitable DNA-dependent RNA polymerase promoter (e.g., the T7 RNA polymerase promoter) and a self-cleaving ribozyme sequence (e.g., the hepatitis delta ribozyme) which is inserted into a propagatable bacterial plasmid. This transcription vector provides the readily manipulable DNA template from which the RNA polymerase (e.g., T7 RNA polymerase) can faithfully transcribe a single-stranded RNA copy of the viral antigenome (or genome) with the precise, or nearly precise, 5' and 3' termini. The orientation of the viral genomic DNA copy and the flanking promoter and ribozyme sequences determine whether antigenome or genome RNA equivalents are transcribed. Also required for rescue of new virus progeny are the virus-specific trans-acting proteins needed to encapsidate the naked, single-stranded viral antigenome or genome RNA



- 18 -

transcripts into functional nucleocapsid templates:  
the viral nucleocapsid (N or NP) protein, the  
polymerase-associated phosphoprotein (P) and the  
polymerase (L) protein. These proteins comprise the  
active viral RNA-dependent RNA polymerase which must  
engage this nucleocapsid template to achieve  
transcription and replication.

The trans-acting proteins required for  
measles virus rescue are the encapsidating protein N,  
and the polymerase complex proteins, P and L. For RSV,  
the virus-specific trans-acting proteins include N, P  
and L, plus an additional protein, M2, the RSV-encoded  
transcription elongation factor.

Typically, these viral trans-acting proteins  
are generated from one or more plasmid expression  
vectors encoding the required proteins, although some  
or all of the required trans-acting proteins may be  
produced within mammalian cells engineered to contain  
and express these virus-specific genes and gene  
products as stable transformants.

The typical (although not necessarily  
exclusive) circumstances for rescue include an  
appropriate mammalian cell milieu in which T7  
polymerase is present to drive transcription of the  
antigenomic (or genomic) single-stranded RNA from the  
viral genomic cDNA-containing transcription vector.  
Either cotranscriptionally or shortly thereafter, this  
viral antigenome (or genome) RNA transcript is  
encapsidated into functional templates by the  
nucleocapsid protein and engaged by the required  
polymerase components produced concurrently from co-  
transfected expression plasmids encoding the required  
virus-specific trans-acting proteins. These events and  
processes lead to the prerequisite transcription of  
viral mRNAs, the replication and amplification of new

- 19 -

genomes and, thereby, the production of novel viral progeny, i.e., rescue.

For the rescue of rabies, VSV and Sendai, T7 polymerase is provided by recombinant vaccinia virus VTF7-3. This system, however, requires that the rescued virus be separated from the vaccinia virus by physical or biochemical means or by repeated passaging in cells or tissues that are not a good host for poxvirus. For MV cDNA rescue, this requirement is avoided by creating a cell line that expresses T7 polymerase, as well as viral N and P proteins. Rescue is achieved by transfecting the genome expression vector and the L gene expression vector into the helper cell line. Advantages of the host-range mutant of the vaccinia virus, MVA-T7, which expresses the T7 RNA polymerase, but produces little or no infectious progeny in mammalian cells, are exploited to rescue RSV, Rinderpest virus and MV. After simultaneous expression of the necessary encapsidating proteins, synthetic full length antigenomic viral RNA are encapsidated, replicated and transcribed by viral polymerase proteins and replicated genomes are packaged into infectious virions. In addition to such antigenomes, genome analogs have now been successfully rescued for Sendai and PIV-3 (21,26).

The rescue system thus provides a composition which comprises a transcription vector comprising an isolated nucleic acid molecule encoding a genome or antigenome of a nonsegmented, negative-sense, single stranded RNA virus of the Order Mononegavirales having (a) for measles virus, at least one attenuating mutation in the N, P or C genes or the F gene-end signal; and (b) for RSV subgroup B, at least one attenuating mutation in the M gene-end signal, together with at least one expression vector which comprises at

- 20 -

least one isolated nucleic acid molecule encoding the trans-acting proteins necessary for encapsidation, transcription and replication (e.g., N, P and L for measles virus; N, P, L and M2 for RSV). Host cells are then transformed or transfected with the at least two expression vectors just described. The host cells are cultured under conditions which permit the co-expression of these vectors so as to produce the infectious attenuated virus.

The rescued infectious virus is then tested for its desired phenotype (temperature sensitivity, cold adaptation, plaque morphology, and transcription and replication attenuation), first by *in vitro* means. The mutations in the N, P or C genes or the F gene-end signal of measles virus and in the M gene-end signal of RSV subgroup B are also tested using the minireplicon system where the required trans-acting encapsidation and polymerase activities are provided by wild-type or vaccine helper viruses, or by plasmids expressing the N, P and different L genes harboring gene-specific attenuating mutations (19,27,83).

If the attenuated phenotype of the rescued virus is present, challenge experiments are conducted with an appropriate animal model. Non-human primates provide the preferred animal model for the pathogenesis of human disease. These primates are first immunized with the attenuated, recombinantly-generated virus, then challenged with the wild-type form of the virus. Monkeys are infected by various routes, including but not limited to intranasal, intratracheal or subcutaneous routes of inoculation (28). Experimentally infected rhesus and cynomolgus macaques have also served as animal models for studies of vaccine-induced protection against measles (29). For evaluating attenuation levels of RSV mutants, the

- 21 -

cotton rat or mouse models may also be used (30,31). Protection is measured by such criteria as disease signs and symptoms, survival, virus shedding and antibody titers. If the desired criteria are met, the attenuated, recombinantly-generated virus is considered a viable vaccine candidate for testing in humans. The "rescued" virus is considered to be "recombinantly-generated", as are the progeny and later generations of the virus, which also incorporate the attenuating mutations.

Even if a "rescued" virus is underattenuated or overattenuated relative to optimum levels for vaccine use, this is information which is valuable for developing such optimum strains.

Optimally, a codon containing an attenuating point mutation may be stabilized by introducing a second or a second plus a third mutation in the codon without changing the amino acid encoded by the codon bearing only the attenuating point mutation.

Infectious virus clones containing the attenuating and stabilizing mutations are also generated using the cDNA "rescue" system described above.

In one embodiment of the invention, measles virus mutations are assessed, because sequence data are now available as described herein for the disease-causing wild-type virus and for the disease-preventing vaccines which have a demonstrated history of efficacy.

Measles virus was first isolated in tissue culture in 1954 (32) from an infected patient named David Edmonston. This Edmonston strain of measles became the progenitor for many live-attenuated measles vaccines including Moraten, which is the current vaccine in the United States (Attenuvax™; Merck Sharp & Dohme, West Point, PA) and was licensed in 1968 and has proven to be efficacious.

- 22 -

Aggressive immunization programs instituted in the mid to late 1960s resulted in the precipitous drop in reported measles cases from near 700,000 in 1965 to 1500 in 1983. In parallel, other vaccine strains were also developed from the Edmonston strain (see Fig. 1), Schwarz (Institut Merieux, Lyon, France), Zagreb (Zagreb, Yugoslavia) and AIK-C (Japan). These other vaccines have also proven to be efficacious and have been used extensively. An early, reactogenic, underattenuated vaccine strain (Rubeovax™: Merck Sharp & Dohme; this may be the same as the Edmonston B strain) produced measles-like illness in children and its use thus was discontinued. It, however, was further attenuated successfully to produce the Moraten vaccine strain (see Fig. 1) (33). Live measles virus vaccine provides a success story of the development of an efficacious vaccine and provides a model for understanding the molecular mechanisms of viral vaccine attenuation among nonsegmented, negative-sense, single stranded RNA viruses.

Because of its significance as a major cause of human morbidity and mortality, measles virus (MV) has been quite extensively studied. MV is a large, relatively spherical, enveloped particle composed of two compartments, a lipoprotein membrane and a ribonucleoprotein particle core, each having distinct biological functions (34). The virion envelope is a host cell-derived plasma membrane modified by three virus-specified proteins: The hemagglutinin (H; approximately 80 kilodaltons (kD)) and fusion (F<sub>1,2</sub>; approximately 60 kD) glycoproteins project on the virion surface and confer host cell attachment and entry capacities to the viral particle (16). Antibodies to H and/or F are considered protective since they neutralize the virus' ability to initiate

- 23 -

infection (35,36,37). The matrix (M; approximately 37 kD) protein is the amphipathic protein lining the membrane's inner surface, which is thought to orchestrate virion morphogenesis and thus consummate virus reproduction (38). The virion core contains the 15,894 nucleotide long genomic RNA upon which template activity is conferred by its intimate association with approximately 2600 molecules of the approximately 60 kD nucleocapsid (N) protein (39,40,41). Loosely associated with this approximately one micron long helical ribonucleoprotein particle are enzymatic levels of the viral RNA dependent RNA polymerase (L; approximately 240 kD) which in concert with the polymerase cofactor (P; approximately 70 kD), and perhaps yet other virus-specified as well as host-encoded proteins, transcribes and replicates the MV genome sequences (42).

Prior to International application PCT/US97/16718, the entire nucleotide sequences (only for the Edmonston B laboratory strain and the AIK-C vaccine strain), coding potential, and organization of the MV genome had been reported (34). The six virion structural proteins are encoded by six contiguous, non-overlapping genes which are arrayed as follows: 3'-N-P-M-F-H-L-5'. Two additional MV gene products of as yet uncertain function have also been identified. These two nonstructural proteins, known as C (approximately 20 kD) and V (approximately 45 kD), are both encoded by the P gene, the former by a second reading frame within the P mRNA; the latter by a cotranscriptionally edited P gene-derived mRNA which encodes a hybrid protein having the amino terminal sequences of P and a new zinc finger-like cysteine-rich carboxy terminal domain (16).

- 24 -

In addition to the sequences encoding the virus-specified proteins, the MV genome contains distinctive non-protein coding domains resembling those directing the transcriptional and replicative pathways of related viruses (16,43). These regulatory signals lie at the 3' and 5' ends of the MV genome and in short internal regions spanning each intercistronic boundary. The former encode the putative promoter and/or regulatory sequence elements directing genomic transcription, genome and antigenome encapsidation, and replication. The latter signal transcription termination and polyadenylation of each monocistronic viral mRNA and then reinitiation of transcription of the next gene. In general, the MV polymerase complex appears to respond to these signals much as the RNA-dependent RNA polymerases of other non-segmented negative strand RNA viruses (16,43,44,45).

Transcription initiates at or near the 3' end of the MV genome and then proceeds in a 5' direction producing monocistronic mRNAs (41,43,46). As the polymerase traverses the MV genomic template, it encounters putative stop/start signals which, in 3' to 5' order, are: a semi-conserved transcription termination/polyadenylation signal (A/G U/C UA A/U NN A<sub>n</sub>, where N may be any of the four bases) at which each monocistronic RNA is completed; a non-transcribed intergenic trinucleotide punctuation mark (CUU; except at the H:L boundary where it is CGU); and a semiconserved start signal for transcription initiation of the next gene (AGG A/G NN C/A A A/G G A/U, where N may be any of the four bases) (46,47). Since some polymerase complexes fail to reinitiate, the abundance of each MV mRNA diminishes in parallel with the distance of the encoding gene from the genomic 3' end. This mRNA gradient directly corresponds to the relative

- 25 -

abundance of each virus-specified protein. This indicates that MV protein expression is ultimately controlled at the transcriptional level (45).

5 The 3' and 5' MV genomic termini contain non-protein coding sequences with distinct parallels to the leader and trailer RNA encoding regions of VSV (43). Nucleotides 1-55 define the region between the genomic 3' terminus and the beginning of the N gene, while 37 additional nucleotides can be found between  
10 the end of the L gene and the 5' terminus of the genome. However, unlike VSV, or even the *paramyxoviruses* Sendai and NDV, MV does not transcribe these terminal regions into short, unmodified (+) or (-) sense leader RNAs (48,49,50). Instead, leader  
15 readthrough transcripts, including full-length polyadenylated leader:N, leader:N:P, leader:N:P:M, and of course full-length antigenome MV RNAs are transcribed (49,50). Thus, the short leader transcript, the key operational element determining the  
20 switch from transcription to replication of the VSV single-stranded, negative polarity genome (51,52,53), seems absent in MV. This leads to consideration and exploration of alternative models for this crucial reproductive event (43).

25 Measles virus, as well as all other Mononegavirales except the rhabdoviruses, appears to have extended its terminal regulatory domains beyond the confines of leader and trailer encoding sequences (43). For measles, these regions encompass the 107 3'  
30 genomic nucleotides (the "3' genomic promoter region", also referred to as the "extended promoter", which comprises 52 nucleotides encoding the leader region, followed by three intergenic nucleotides, and 52 nucleotides encoding the 5' untranslated region of N  
35 mRNA) and the 109 5' end nucleotides (69 encoding the



- 26 -

3' untranslated region of L mRNA, the intergenic trinucleotide and 37 nucleotides encoding the trailer). Within these 3' terminal approximately 100 nucleotides of both the genome and antigenome are two short regions of shared nucleotide sequence: 14 of 16 nucleotides at the absolute 3' ends of the genome and antigenome are identical. Internal to those termini, an additional region of 12 nucleotides of absolute sequence identity have been located. Their position at and near the sites at which the transcription of the MV genome must initiate and replication of the antigenome must begin, suggests that these short unique sequence domains encompass an extended promoter region.

These discrete sequence elements may dictate alternative sites of transcription initiation -- the internal domain mandating transcription initiation at the N gene start site, and the 3' terminal domain directing antigenome production (43,49,54). In addition to their regulatory role as cis-acting determinants of transcription and replication, these 3' extended genomic and antigenomic promoter regions encode the nascent 5' ends of antigenome and genome RNAs, respectively. Within these nascent RNAs reside as yet unidentified signals for N protein nucleation, another key regulatory element required for nucleocapsid template formation and consequently for amplification of transcription and replication. Figure 2 schematically shows the location and sequence of these highly conserved, putative cis-acting regulatory domains.

Terminal non-protein coding regions similar in location, size and spacing are present in the genomes of other members of the genus *Paramyxoviridae*, though only 8-11 of their absolute terminal nucleotides are shared by MV (43,55). The genomic termini of the

- 27 -

Morbillivirus canine distemper virus (CDV) displays a greater degree of homology with its MV relative: 73% of the nucleotides of the leader and trailer sequences of these two viruses are identical, including 16 of 18 at the absolute 3' termini and 17 of 18 at their 5' ends (56). No accessory internal CDV genomic domain-sharing homology to that of the MV extended promoter has been found. However, there is a 20 nucleotide long stretch lying between CDV genomic nucleotides 85 and 104 and 15,587 and 15,606 in which 15 of the 20 nucleotides are complementary (Gene Bank accession number AF 14953). This indicates that CDV, like MV contains an additional region within its non-coding 3' genomic and antigenomic ends that may provide important cis-acting promoter and/or regulatory signals (56).

Additionally, the precise length of the 3'-leader region (55 nucleotides) is identical among several members of the Family Paramyxoviridae (MV, CDV, PIV-3, BPV-3, SV and NDV). Further evidence for the importance of these extended, non-protein coding regions comes from analyses of a large number of distinct copy-back Defective Interfering genomes (DIs) recently cloned from subacute sclerosing panencephalitis (SSPE) brain tissue. No DI with a stem shorter than the 95 5' terminal genomic nucleotides was found. This indicates that the minimal signals needed for MV DI RNA replication and encapsidation extend well beyond the 37 nucleotide long trailer sequence to encompass the additional internal putative regulatory domain (57).

In all Paramyxoviruses, the cis-acting signals required for essential viral functions, including replication, transcription and encapsidation are contained in the non-coding genomic termini. The obligatory trans-acting elements for functionality are

- 28 -

contained in the N, P and L genes. Mutations in any of these regions may result in alteration of vital functions, including attenuation of viral transcription/replication efficiency.

5           The attenuation potential in the cis-acting sequence elements and in the trans-acting protein genes has been demonstrated in several viral systems by sequence analysis of their genomes (58,59).

10           The measles embodiment of this invention involved an analysis of the nucleotide sequences of the progenitor Edmonston wild-type MV isolate, together with available measles vaccine strains derived from this isolate (see Figure 1). Independent other wild-type isolates were examined for comparative purposes as well. In particular, the emphasis was on regions other than the 3' genomic promoter region and the L gene; those regions were the focus of International application PCT/US97/16718.

20           The nucleotide sequences (in positive strand, antigenomic, message sense) of four wild-type and five vaccine measles strains are set forth as follows with reference to the appropriate SEQ ID NOS. contained herein:

25	<u>Virus</u>	<u>Nucleotide Sequence</u>
	<u>Wild-Type</u>	
	Edmonston	SEQ ID NO:1
	1977	SEQ ID NO:2
	1983	SEQ ID NO:3
30	Montefiore	SEQ ID NO:4
	<u>Vaccine</u>	
	Rubeovax™	SEQ ID NO:5
	Moraten	SEQ ID NO:6
35	Zagreb	SEQ ID NO:7

- 29 -

AIK-C

SEQ ID NO:8

Each measles virus genome listed above is 15,894 nucleotides in length. Translation of the N gene starts with the codon at nucleotides 108-110; the translation stop codon is at nucleotides 1683-1685. The translated N protein is 525 amino acids long. Translation of the P gene starts with the codon at nucleotides 1807-1809; the translation stop codon is at nucleotides 3328-3330. The translated P protein is 506 amino acids long. Translation of the C gene starts with the codon at nucleotides 1829-1831; the translation stop codon is at nucleotides 2387-2389. The translated C protein is 189 amino acids long. Translation of the F gene starts with the codon at nucleotides 5449-5451; the translation stop codon is at nucleotides 7108-7110. The translated F protein is 553 amino acids long. The F gene stop/polyadenylation signal includes an eleven nucleotide gene-end signal at nucleotides 7237-7247, followed by an intergenic region at nucleotides 7248-7250 and the H gene-start signal at nucleotides 7251-7260.

Note that nucleotide 2499 of 1983 wild-type measles virus is indicated as "G" in SEQ ID NO:3. In fact, the base is actually a mixture of "G" and "C". Also note that nucleotide 2143 of Rubeovax™ vaccine virus is indicated as "T" in SEQ ID NO:5. In nine clones sequenced, this base was "T" in seven and "C" in two; thus, this base can be "T" or "C".

In addition, the Schwarz vaccine virus genome is identical to that of the Moraten vaccine virus genome (SEQ ID NO:6).

An analysis of the coding and noncoding (intercistronic) regions of the MV genome was carried out. Nucleotide and amino acid differences

- 30 -

distinguishing the N, P and C gene and protein sequences, and nucleotide differences distinguishing the F gene-end signal in the F/H intercistronic region of the Edmonston wild-type isolate, vaccine strains and  
5 other independently isolated wild-type viruses were compared and aligned (see Tables 3-5 in Example 1 below).

As shown in Table 3, there are five nucleotide changes in the N genes of MV vaccine strains  
10 compared to the progenitor Edmonston wild-type isolate. Two of these changes, at nucleotides 275 and 623, were conservative changes which did not result in changes to the amino acid sequence. Three changes, at nucleotides 492, 550 and 1542, resulted in changes to the amino  
15 acid sequence of certain of the vaccine strains: (1) a change from a "C" to an "A" at nucleotide 492 resulted in a mutation from glutamine to lysine at amino acid 129 for the AIK-C vaccine strain; (2) a change from an "A" to a "G" at nucleotide 550 resulted  
20 in a mutation from glutamic acid to glycine at amino acid 148 for the Moraten and Schwarz vaccine strains; and (3) a change from a "T" to an "A" at nucleotide 1542 resulted in a mutation from serine to threonine at amino acid 479 for the Rubeovax™, Moraten and Schwarz  
25 vaccine strains. Because none of these three mutations were present in any of the later wild-type isolates, these three N gene mutations are potentially attenuating in the vaccine strains.

Without being bound by theory, the  
30 attenuating phenotype of these three N gene mutations may be based upon the following discussion. The N protein must serve a number of functions in the measles virus life cycle. It must be able to interact with the viral genomic RNA and other copies of N to form the  
35 nucleocapsid complex in which the MV genome is always

- 31 -

found. It interacts with the polymerase complex to allow transcription and replication. It has also been found to interact with the P protein separate from the replication complex. All of these functions could be points at which mutations might result in attenuation by affecting replicational efficiency of the virus.

Based on the deletion analysis of Bankamp et al. (60), the changes observed in the Edmonston vaccine lineage fall into areas that affect the functionality of the N protein as outlined below:

(1) Changes at amino acid 129 (glutamine to lysine in AIK-C) and amino acid 148 (glutamic acid to glycine in Moraten and Schwarz) both fall into a region necessary for the interaction of N and P proteins in solution. This interaction helps to keep the N protein from aggregating in a non-nucleocapsid specific manner. The P protein is also thought to serve as a chaperone, delivering N protein to the replicating genome for use in encapsidation. In Sendai virus, the first 400 amino acids comprise a domain that is also involved in the ability to encapsidate RNA, suggesting that at least some part of this region interacts with the RNA.

(2) The change at amino acid 479 (serine to threonine in Rubeovax™, Moraten, and Schwarz) falls within an area, that when deleted results in the formation of unstructured aggregates; this suggests it is an area of N:N interaction. This carboxy-terminal region of the N protein has also been shown in Sendai virus to interact with the P protein when assembled in nucleocapsids. In addition, the sequence from amino acid 400 to the carboxy-terminus (amino acid 525) shows a noticeably higher level of variation among wild-type MV N proteins compared to the rest of the protein.

As shown in Table 4, there are three nucleotide change in the P gene and three nucleotide

- 32 -

changes in the C gene of MV vaccine strains compared to the progenitor Edmonston wild-type isolate. The first change in the P gene, from "A" to "G" at nucleotide 2480, resulted in a mutation from glutamic acid to glycine at amino acid 225 for all vaccine strains; however, this change was not present in any of the later wild-type isolates. This unique mutation in the P protein is in one of the less conserved Morbillivirus amino acids: It is glutamic acid in both the wild-type and vaccine strains of the rinderpest virus, and cysteine in the canine distemper and phocine distemper virus strains (58). However, because this unique mutation is common to all the MV vaccine strains examined, but was not present in the later wild-type isolates, it is viewed as a potentially attenuating mutation.

The P and V mRNAs share the same start codon and the first 231 amino acids of the P and V proteins are identical. The V mRNA has an extra "G" between nucleotides 2498 and 2499 of the P mRNA. Editing takes place during transcription when an extra non-template-directed "G" residue is inserted between nucleotides 2498 and 2499, causing a shift in the reading frame, whereby the carboxy-terminal 276 amino acids of the P protein are replaced with a 68 amino acid cysteine-rich carboxy-terminus of the V protein. However, the mutation encoding amino acid 225 is located before the extra "G", so that mutation is potentially attenuating for both the P and the V proteins. At the present time, the function of the V protein is not known.

The second change in the P gene, from "G" to "A" at nucleotide 2630, resulted in a mutation from cysteine to tyrosine at amino acid 275. The third change in the P gene, from "T" to "C" at nucleotide 3122, resulted in a mutation from leucine to proline at

- 33 -

amino acid 439. These two mutations were unique to the AIK-C vaccine strain -- they were not present in the other vaccine strains or in any of the wild-type isolates -- and, therefore, they are viewed as potentially attenuating.

The first change in the C gene, from "C" to "T" at nucleotide 2046, resulted in a mutation from alanine to valine at amino acid 73 for all later wild-type isolates, as well as for all vaccine strains. Because of the presence of this mutation in the vaccine strains, but not in the progenitor wild-type strain, this mutation is viewed as potentially attenuating.

The next change in the C gene, from "T" to "C" at nucleotide 2139, resulted in a mutation from methionine to threonine at amino acid 104 for the Rubeovax™, Moraten and Schwarz vaccine strains. Because this mutation was not present in any of the later wild-type isolates, this C gene mutation is potentially attenuating in the vaccine strains.

The third change in the C gene, from "C" to "A" at nucleotide 2229, resulted in a mutation from serine to tyrosine at amino acid 134. This mutation was unique to the AIK-C vaccine strain -- it is not present in the other vaccine strains or in any of the other wild-type strains -- and, therefore, it is viewed as potentially attenuating.

The regions comprising the cis-acting elements which control transcription initiation and termination for each MV gene were found to be highly conserved among all measles viruses examined. With one exception, the sequences of the gene-start and gene-end signals were identical for all the viruses analyzed.

However, as shown in Table 5, there was one mutation in the F gene-end signal which spans nucleotides 7237-7247 (in antigenomic, message sense)



- 34 -

in two of the vaccine strains -- Moraten and Schwarz -- compared to the progenitor wild-type MV isolate, other derivative vaccine strains and other wild-type isolates: At nucleotide position 7243, Moraten and Schwarz had a "A", whereas the wild-type isolates and the other vaccine strains had a "T".

This F gene-end signal mutation is thought to affect the efficiency of transcription termination, which in turn could affect the levels of F gene expression, as well as downstream H gene expression. Decreases in F and H gene expression potentially are partially responsible for attenuation of the Moraten and Schwarz vaccine strains. This is consistent with the suggestion that a decrease in MV F gene expression may be a factor in attenuation (61). The importance of mutations in gene-start and gene-end signals was exemplified by the observation that a change in the RSV M2 gene-start signal had a profound attenuating effect on the virus and was associated with the *ts* phenotype of the virus (62).

Based on Table 3 and the foregoing discussion, the key attenuating sites for the MV N protein are as follows: amino acid residues 129 (glutamine → lysine), 148 (glutamic acid → glycine) and 479 (serine → threonine). Based on Table 4 and the foregoing discussion, the key attenuating sites for the P and C proteins are as follows: amino acid residues 225 (glutamic acid → glycine), 275 (cysteine → tyrosine) and 439 (leucine → proline) for the P protein and amino acid residues 73 (alanine → valine), 104 (methionine → threonine) and 134 (serine → tyrosine) for the C protein.

It is understood that the nucleotide changes responsible for these amino acid changes are not limited to those set forth in Tables 3 and 4 of Example

- 35 -

1 below; all changes in nucleotides which result in codons which are translated into these amino acids are within the scope of this invention.

5 In addition, based on Table 5 and the foregoing discussion, the key attenuating mutation for the F gene-end signal is nucleotide 7243 (T → C) (in antigenomic, message sense).

10 In a further embodiment of this invention, the measles virus phenotype is further attenuated by combining one or more of the above-referenced N, P or C gene or F gene-end signal mutations with one or more of each of the coordinate 3' genomic promoter region and L gene mutations described in International application PCT/US97/16718, which are as follows: for the MV 3' genomic promoter region, the mutations are nucleotide 15 26 (A → T), nucleotide 42 (A → T or A → C) and nucleotide 96 (G → A) (in antigenomic, message sense), while for the L protein the mutations are amino acid residues 331 (isoleucine → threonine), 1409 (alanine → threonine), 1624 (threonine → alanine), 1649 20 (arginine → methionine), 1717 (aspartic acid → alanine), 1936 (histidine → tyrosine), 2074 (glutamine → arginine) and 2114 (arginine → lysine). Again, it is understood that all changes in nucleotides 25 which result in codons which are translated into these amino acids are within the scope of this invention.

Human respiratory syncytial virus (RSV) is another nonsegmented, negative-sense, single stranded enveloped RNA virus. RSV belongs to the Subfamily 30 Pneumovirinae and the genus *Pneumovirus* (see Table 1).

Two major subgroups of human RSV, designated A and B, have been identified based on reactivities of the F and G surface glycoproteins with monoclonal antibodies (63). More recently, the A and B lineages

- 36 -

of RSV strains have been confirmed by sequence analysis (64,65). Bovine, ovine, and caprine strains of this virus have also been isolated. The host specificity of the virus is most clearly associated with the G attachment protein, which is highly divergent between the human and the bovine/ovine strains (66,67), and may be influenced, at least in part, by receptor binding.

RSV is the primary cause of serious viral pneumonia and bronchiolitis in infants and young children. Serious disease, i.e., lower respiratory tract disease (LRD), is most prevalent in infants less than six months of age. It most commonly occurs in the nonimmune infant's first exposure to RSV. RSV additionally is associated with asthma and hyperreactive airways and it is a significant cause of mortality in "high risk" children with bronchopulmonary dysplasia and congenital heart disease (CHD). It is also one of the common viral respiratory infections predisposing to otitis media in children. In adults, RSV generally presents as uncomplicated upper respiratory illness; however, in the elderly it rivals influenza as a predisposing factor in the development of serious LRD, particularly bacterial bronchitis and pneumonia. Disease is always confined to the respiratory tract, except in the severely immunocompromised, where dissemination to other organs can occur. Virus is spread to others by fomites contaminated with virus-containing respiratory secretions, and infection initiates through the nasal, oral, or conjunctival mucosa.

RSV disease is seasonal and virus is usually isolated only in the winter months, e.g., from November to April in northern latitudes. The virus is ubiquitous, and over 90% of children have been infected at least once by 2 years of age. Multiple strains

- 37 -

cocirculate. There is no direct evidence of antigenic drift (such as that seen with influenza A viruses), but sequence studies demonstrating accumulation of amino acid changes in the hypervariable regions of the G protein and SH proteins suggest that immune pressure may drive virus evolution.

In mouse and cotton rat models, both the F and G proteins of RSV elicit neutralizing antibodies and immunization with these proteins alone provides longterm protection against reinfection (68,69).

In humans, complete immunity to RSV does not develop and reinfections occur throughout life (70,71); however, there is evidence that immune factors will protect against severe disease. A decrease in severity of disease is associated with two or more prior infections and there is evidence that children infected with one of the two major RSV subgroups may be somewhat protected against reinfection with the homologous subgroup (72), observations which suggest that a live attenuated virus vaccine may provide protection sufficient to prevent serious morbidity and mortality. Infection with RSV elicits both antibody and cell mediated immunity. Serum neutralizing antibody to the F and G proteins has been associated, in some studies, with protection from LRD, although reduction in upper respiratory disease (URD) has not been demonstrated. High levels of serum antibody in infants is associated with protection against LRD, and administration of intravenous immunoglobulin with high RSV neutralizing antibody titers has been shown to protect against severe disease in high risk children (71,73,74). The role of local immunity, and nasal antibody in particular, is being investigated.

The RSV virion consists of a ribonucleoprotein core contained within a lipoprotein

- 38 -

envelope. The virions of pneumoviruses are similar in size and shape to those of all other paramyxoviruses. When visualized by negative staining and electron microscopy, virions are irregular in shape and range in diameter from 150-300 nm (75). The nucleocapsid of this virus is a symmetrical helix similar to that of other paramyxoviruses, except that the helical diameter is 12-15 nm rather than 18nm. The envelope consists of a lipid bilayer that is derived from the host membrane and contains virally coded transmembrane surface glycoproteins. The viral glycoproteins mediate attachment and penetration and are organized separately into virion spikes. All members of the paramyxovirus subfamily have hemagglutinating activity, but this function is not a defining feature for pneumoviruses, being absent in RSV but present in Pneumovirus of mice (PVM) (76). Neuraminidase activity is present in members of the genera Paramyxovirus, Rubulavirus, and is absent in Morbillivirus and Pneumovirus (76).

RSV possesses two subgroups, designated A and B. The wild-type RSV (strain 2B) genome is a single strand of negative-sense RNA of 15,218 nucleotides (SEQ ID NO:9) that are transcribed into ten major subgenomic mRNAs which encode eleven gene products. Each of the ten mRNAs encodes a major polypeptide chain: Three are transmembrane surface proteins (G, F and SH); three are the proteins associated with genomic RNA to form the viral nucleocapsid (N, P and L); two are nonstructural proteins (NS1 and NS2) which accumulate in the infected cells but are also present in the virion in trace amounts and may play a role in regulating transcription and replication; one is the nonglycosylated virion matrix protein (M); and the last is M2, another nonglycosylated protein recently shown to be an RSV-specified transcription elongation factor (see Figure

- 39 -

3) (another gene product is also encoded by the M2 gene). These ten viral proteins account for nearly all of the viral coding capacity.

5       The viral genome is encapsidated with the major nucleocapsid protein (N), and is associated with the phosphoprotein (P), and the large (L) polymerase protein. These three proteins have been shown to be necessary and sufficient for directing RNA replication of cDNA encoded RSV minigenomes (77). Further studies  
10       have shown that for transcription to proceed with full processing, the M2 protein (ORF 1) is required (75). When the M2 protein is missing, truncated transcripts predominate, and rescue of the full length genome does not occur (75).

15       Both the M (matrix protein) and the M2 proteins are internal virion-associated proteins that are not present in the nucleocapsid structure. By analogy with other nonsegmented negative-stranded RNA viruses, the M protein is thought to render the  
20       nucleocapsid transcriptionally inactive before packaging and to mediate its association with the viral envelope. The NS1 and NS2 proteins have only been detected in very small amounts in purified virions, and at this time are considered non-structural. Their  
25       functions are uncertain, though they may be regulators of transcription and replication. Three transmembrane surface glycoproteins are present in virions: G, F, and SH. G and F (fusion) are envelope glycoproteins that are known to mediate attachment and penetration of the  
30       virus into the host cell. In addition, these glycoproteins represent major independent immunogens (78). The function of the SH protein is unknown, although a recent report has implicated its involvement in the fusion function of the virus (79).

- 40 -

As discussed below, the genomes of two wild-type RSV subgroup B strains (2B and 18537) were sequenced in their entirety, as described in International application PCT/US9716718 (see SEQ ID NOS:9 and 10). Genomic RNA is neither capped nor polyadenylated (80). In both the virion and intracellularly, genomic RNA is tightly associated with the N protein.

The 3' end of the genomic RNA consists of a 44-nucleotide extragenic leader region that is presumed to contain the major viral promoter (Fig. 3). The 3' genomic promoter region is followed by ten viral genes in the order 3'-NS1-NS2-N-P-M-SH-G-F-M2-L-5' (Fig. 3). The L gene is followed by a 145-149 nucleotide extragenic trailer region (see Figure 3). Each gene begins with a conserved nine-nucleotide gene start signal 3'-GGGGCAAAU (except for the ten-nucleotide gene start signal of the L gene, which is 3'-GGGACAAAAU; and the gene start signal of the SH gene for 2B and 18537, which is 3'-GGGGUAAAAU; differences underlined). For each gene, transcription begins at the first nucleotide of the signal. Each gene terminates with a semi-conserved 12-14 nucleotide gene end (3'-A G U/G U/A ANNN U/A A<sub>3-5</sub>) (where N can be any of the four bases) that directs transcription termination and polyadenylation (Fig. 3). The first nine genes are non-overlapping and are separated by intergenic regions that range in size from 3 to 56 nucleotides for RSV B strains (Fig. 3). The intergenic regions do not contain any conserved motifs or any obvious features of secondary structure and have been shown to have no influence on the preceding and succeeding gene expression in a minireplicon system (Fig. 3). The last two RSV genes overlap by 68 nucleotides (Fig. 3). The gene-start signal of the L gene is located inside of,

- 41 -

rather than after, the M2 gene. This 68 nucleotide overlap sequence encodes the last 68 nucleotides of the M2 mRNA (exclusive of the Poly-A tail), as well as the first 68 nucleotides of the L mRNA.

5           Ten different species of subgenomic polyadenylated mRNAs and a number of polycistronic polyadenylated read-through transcripts are the products of genomic transcription (75).  
10       Transcriptional mapping studies using UV light mediated genomic inactivation showed that RSV genes are transcribed in their 3' to 5' order from a single promoter near the 3' end (81). Thus, RSV synthesis appears to follow the single entry, sequential transcription model proposed for all Mononegavirales  
15       (16,82). According to this model, the polymerase (L) contacts genomic RNA in the nucleocapsid form at the 3' genomic promoter region and begins transcription at the first nucleotide. RSV mRNAs are co-linear copies of the genes, with no evidence of mRNA editing or  
20       splicing.

          Sequence analysis of intracellular RSV mRNAs showed that synthesis of each transcript begins at the first nucleotide of the gene start signal (75). The 5' end of the mRNAs are capped with the structure  
25       m<sup>7</sup>G(5')ppp(5')Gp (where the underlined G is the first template nucleotide of the mRNA) and the mRNAs are polyadenylated at their 3' ends (83). Both of these modifications are thought to be made co-transcriptionally by the viral polymerase. Three  
30       regions of the RSV 3' genomic promoter have been found to be important as cis acting elements (84). These regions are the first ten nucleotides (presumably acting as a promoter), nucleotides 21-25, and the gene start signal located at nucleotides 45-53 (84). Unlike  
35       other Paramyxovirinae, such as measles, Sendai and PIV-



- 42 -

3, the remainder of the leader and non-coding region of NS1 gene of RSV was found to be highly tolerant of insertions, deletions and substitutions (84).

5           Additionally, by saturation mutagenesis  
(wherein each base is replaced independently by each of the other three bases and compared for translation and replication efficiencies) within the first 12 nucleotides of the 3' genomic promoter region, a U-tract located at nucleotides 6-10 was shown to be quite  
10           intolerant of substitutions (84). In contrast, the first five nucleotides were relatively tolerant of a number of substitutions and two of them at position four were up-regulatory mutations, resulting in a four- to 20-fold increase in RSV-CAT RNA replication and  
15           transcription. Using a bi-cistronic minireplicon system, gene-start and gene-end motifs were shown to be signals for mRNA synthesis and appear to be self-contained and largely independent of the nature of adjoining sequence (85).

20           The L gene start signal lies 68 nucleotides upstream of the M2 gene-end signal, resulting in gene overlap (Fig. 3) (75). The presence of the M2 gene-end signal within the L gene results in a high frequency of premature termination of L gene transcripts. Full  
25           length L mRNA is much less abundant and is made when the polymerase fails to recognize the M2 gene-end motif. This results in much lower transcription of L mRNA. The gene overlap seems incompatible with a model of linear sequential transcription. It is not known  
30           whether the polymerase that exits the M2 gene jumps backward to the L gene-start signal or whether there is a second, internal promoter for L gene transcription (75). It is also possible that the L gene is accessible by a small fraction of polymerases that fail

- 43 -

to start transcription at the M2 gene-start signal and slide down the M2 gene to the L gene-start signal.

5 The relative abundance of each RSV mRNA decreases with the distance of its gene from the promoter, presumably due to polymerase fall-off during sequential transcription (81). Gene overlap is a second mechanism that reduces the synthesis of full length L mRNA. Also, certain mRNAs have features that might reduce the efficiency of translation. The  
10 initiation codon for SH mRNA is in a suboptimal Kozak sequence context, while the G ORF begins at the second methionyl codon in the mRNA.

RSV RNA replication is thought (75) to follow the model proposed from studies with vesicular  
15 stomatitis virus and Sendai virus (16,82). This involves a switch from the stop-start mode of mRNA synthesis to an antiterminator read-through, the latter resulting in synthesis of positive sense replication-intermediate (RI) RNA that is an exact complementary  
20 copy of genomic RNA. This serves in turn as the template for the synthesis of progeny genomes. The mechanism involved in the switch to the antiterminator mode is proposed to involve cotranscriptional encapsidation of the nascent RNA by N protein (16,82).  
25 RNA replication in RSV like other nonsegmented negative-strand RNA viruses is dependent on ongoing protein synthesis (86). Predicted RI RNA has been detected for the standard virus as well as RSV-CAT minigenome (75,86). RI RNA was 10-20 fold less  
30 abundant intracellularly than was the progeny genome both for the standard and the minigenome system.

The RSV subgroup B embodiment of this invention involved an analysis of the nucleotide sequences of various wild-type, vaccine and revertant  
35 RSV strains. In particular, the emphasis was on

- 44 -

regions other than the 3' genomic promoter region and the L gene; those regions were the focus of International application PCT/US97/16718.

5 The nucleotide sequences (in positive strand, antigenomic, message sense) of various wild-type, vaccine and revertant RSV subgroup B strains are set forth as follows with reference to the appropriate SEQ ID NOS. contained herein:

10	<u>Virus</u>	<u>Nucleotide Sequence</u>	<u>Genome</u>
	<u>Wild-Type</u>		<u>Length</u>
	2B	SEQ ID NO:9	15218
	18537	SEQ ID NO:10	15229
15	<u>Vaccine</u>		
	2B33F	SEQ ID NO:11	15219
	2B20L	SEQ ID NO:12	15219
	<u>Revertant</u>		
20	2B33F TS(+)	SEQ ID NO:13	15219
	2B20L TS(+)	SEQ ID NO:14	15219

25 Translation of the M gene starts with the codon at nucleotides 3262-3264; the translation stop codon is at nucleotides 4030-4032. The translated M protein is 256 amino acids long. The M gene stop/polyadenylation signal includes a twelve nucleotide gene-end signal at nucleotides 4196-4207, followed by an intergenic region at nucleotides 4208-

30 4216 and the SH gene-start signal at nucleotides 4217-4225.

35 An analysis of the coding and noncoding (intercistronic) regions of the RSV subgroup B genome was carried out. Nucleotide and amino acid differences distinguishing the SH gene and protein sequences, and

- 45 -

nucleotide differences distinguishing the M gene-end signal in the M/SH intercistronic region of various wild-type, vaccine and revertant RSV strains were carried out (see Tables 6, 7 and 9 in Example 2 below).

5           The regions comprising the cis-acting elements which control transcription termination for each gene were found to be highly conserved among all RSV subgroup B viruses examined. With one exception, the sequences of the gene-start and gene-end signals  
10       were identical for all the viruses analyzed. The third nucleotide of the M gene-end signal of the wild-type 2B, vaccine 2B33F and revertant 2B33F TS(+) strains was a G, while the third nucleotide of all other RSV subgroup B gene-end signals was a T.

15           More importantly, as shown in Table 7, there was one mutation in the M gene-end signal which spans nucleotides 4196-4207 in the wild-type 2B virus (in antigenomic, message sense) and spans nucleotides 4197-4208 in the 2B33F vaccine strain and the 2B33F TS(+) revertant strain: At nucleotide position 4199, wild-type 2B virus had a "T", whereas the 2B33F and 2B33F  
20       TS(+) strains had a "C" in the corresponding nucleotide position 4200 (these strains have an extra nucleotide in their 3' genomic promoter regions). This mutation  
25       was not present in any of the 18537 wild-type strain, the 2B20L vaccine strain or its TS(+) revertant strain.

          As shown in Table 11 and Figures 4-6, the sequence of the M gene-end signal impacts SH gene expression. The RSV subgroup B 2B33F mutant and its  
30       TS(+) revertant have this unique nucleotide at this fourth position of the M gene-end signal (at nucleotide 4200 in the mutant and revertant) that is not found in their 2B parental strain (at nucleotide 4199) or in any of the other RSV subgroup B or A viruses analyzed.

- 46 -

As shown by Northern blot analyses (Figures 4 and 6) and a ribonuclease protection assay (Figure 5) which are discussed in Example 2 below, the wild-type 2B strain produced a slight excess of bicistronic M:SH over monocistronic M transcripts. In contrast the 2B33F mutant and its 2B33F TS(+) revertant produced practically no monocistronic M and SH transcripts; instead, the bulk of their transcription products were bicistronic and higher molecular weight read-through transcripts. These bicistronic and read-through transcripts are likely to be constrained in their ability to translate the SH gene product. Thus, the strains containing this mutation have down-regulated SH expression compared to the 2B parental strain, and have essentially stopped producing the SH protein. This shift to the predominance of bicistronic transcription products and the concomitant down-regulation of the downstream gene product, SH, provides evidence that the mutation in the M gene-end signal contributes to the attenuation phenotype of these two strains.

Therefore, based on Tables 6-11, Figures 4-6 and the foregoing discussion, the key attenuating mutation for the M gene-end signal is nucleotide 4199 (T → C) (in antigenomic, message sense).

It is interesting to note that the SH gene of the 2B33F mutant is blistered with nucleotide changes (biased hypermutation) compared to that of the 2B parent (see Table 6), some of which would result in amino acid substitutions in the SH protein. One change at nucleotide 4498 of 2B33F converts the predicted SH translation stop codon to glutamine. This results in a predicted length for the 2B33F SH protein that is substantially longer than that of the 2B parent.

In a further embodiment of this invention, the RSV subgroup B phenotype is further attenuated by

- 47 -

combining the above-referenced M gene-end signal mutation with one or more of each of the coordinate 3' genomic promoter region and L gene mutations described in International application PCT/US97/16718, which are as follows: for the RSV subgroup B 3' genomic promoter region, the mutations are nucleotide 4 (C → G), and the insertion of an additional A in the stretch of A's at nucleotides 6-11 (in antigenomic message sense), while for the L protein the mutations are amino acid residues 353 (arginine → lysine), 451 (lysine → arginine), 1229 (aspartic acid → asparagine), 2029 (threonine → isoleucine) and 2050 (asparagine → aspartic acid). Again, it is understood that all changes in nucleotides which result in codons which are translated into these amino acids are within the scope of this invention.

When the 3' genomic promoter region is modified by the insertion of an additional A in the stretch of A's at nucleotides 6-11, it is understood that the attenuating mutation in the M gene-end signal will be at nucleotide 4200, rather than nucleotide 4199.

The attenuated viruses of this invention exhibit a substantial reduction of virulence compared to wild-type viruses which infect human and animal hosts. The extent of attenuation is such that symptoms of infection will not arise in most immunized individuals, but the virus will retain sufficient replication competence to be infectious in and elicit the desired immune response profile in the vaccinee.

The attenuated viruses of this invention may be used to formulate a vaccine. To do so, the attenuated virus is adjusted to an appropriate concentration and formulated with any suitable vaccine adjuvant, diluent or carrier. Physiologically

- 48 -

acceptable media may be used as carriers. These include, but are not limited to: an appropriate isotonic medium, phosphate buffered saline and the like. Suitable adjuvants include, but are not limited to MPL™ (3-O-deacylated monophosphoryl lipid A; RIBI ImmunoChem Research, Inc., Hamilton, MT) and IL-12 (Genetics Institute, Cambridge, MA).

In one embodiment of this invention, the formulation including the attenuated virus is intended for use as a vaccine. The attenuated virus may be mixed with cryoprotective additives or stabilizers such as proteins (e.g., albumin, gelatin), sugars (e.g., sucrose, lactose, sorbitol), amino acids (e.g., sodium glutamate), saline, or other protective agents. This mixture is maintained in a liquid state, or is then dessicated or lyophilized for transport and storage and mixed with water immediately prior to administration.

Formulations comprising the attenuated viruses of this invention are useful to immunize a human or animal subject to induce protection against infection by the wild-type counterpart of the attenuated virus. Thus, this invention further provides a method of immunizing a subject to induce protection against infection by an RNA virus of the Order Mononegavirales by administering to the subject an effective immunizing amount of a vaccine formulation incorporating an attenuated version of that virus as described hereinabove.

A sufficient amount of the vaccine in an appropriate number of doses must be administered to the subject to elicit an immune response. Persons skilled in the art will readily be able to determine such amounts and dosages. Administration may be by any conventional effective form, such as intranasally, parenterally, orally, or topically applied to any

- 49 -

mucosal surface such as intranasal, oral, eye, lung, vaginal or rectal surface, such as by an aerosol spray. The preferred means of administration is by intranasal administration.

5           In connection with International application PCT/US97/16718, samples of the Moraten measles virus vaccine strain were deposited by Applicants on August 21, 1997 with the American Type Culture Collection, 12301 Parklawn Drive, Rockville, Maryland 20852, 10 U.S.A., under the provisions of the Budapest Treaty for the Deposit of Microorganisms for the Purposes of Patent Procedures ("Budapest Treaty") and have been assigned ATCC accession number VR2587, and samples of the 2B wild-type RSV virus were deposited by Applicants 15 on August 21, 1997 with the American Type Culture Collection, 12301 Parklawn Drive, Rockville, Maryland 20852, U.S.A., under the provisions of the Budapest Treaty and have been assigned ATCC accession number VR2586.

20           Given these two deposited strains and the sequence information for these and other strains provided herein, one can use site-directed mutagenesis and rescue techniques described above to introduce mutations (or restore a wild-type genotype) of all the 25 strains described herein, as well as taking these strains and making additional mutations from the panel of mutations set forth in Tables 3-11 below.

30           In order that this invention may be better understood, the following examples are set forth. The examples are for the purpose of illustration only and are not to be construed as limiting the scope of the invention.

35



- 50 -

Examples

Standard molecular biology techniques are utilized according to the protocols described in Sambrook et al. (87).

Example 1Measles

Moraten MV vaccine virus was grown once, directly from the Attenuvax™ vaccine vial (Lot #0716B), the Schwarz vaccine virus was grown once (Lot 96G04/M179 G41D), while the Zagreb and Rubeovax™ vaccine viruses were each grown twice in the Vero cells before RNAs were made for sequence analysis. MV wildtype isolate Montefiore (57) was passed 5-6 times in Vero cells before extraction of RNA materials and similarly, MV wildtype isolates 1977, 1983 (14) were grown 5-7 times before extracting materials for analysis. Edmonston wild-type isolate received from Dr. J. Beeler (CBER) (see Fig. 1) was the original Edmonston isolate already passaged seven times in human kidney cells and three times in Vero cells before receipt and further passaged once in Vero cells before using for sequence analysis.

RNA was prepared by infecting Vero cells at a multiplicity of infection (m.o.i.) of 0.1 to 1.0 and allowed to reach maximum cytopathology before being harvested. Total RNA from measles virus-infected cells was extracted using Trizol™ reagent (Gibco-BRL).

The total RNA isolated from Vero cell passage material was amplified by the Reverse Transcriptase-PCR (Perkin-Elmer/Cetus) procedure using measles (Edmonston B strain (19)) specific primer pairs spanning the 3' and 5' promoter regions and the L gene of the viral

- 51 -

genome. Table 2 presents these primer sequences. The primers of SEQ ID NOS:15-34, 54, 57 and 58 are in antigenomic message sense. The primers of SEQ ID NOS:35-53, 55, 56 and 59 are in genomic negative-sense.

5

Table 2  
Primers for PCR and Sequencing MV L Genes  
and Genomic Termini

10

9047 CATATCACTCACTCTGGGATGGAG<sub>9070</sub> (SEQ ID NO:15)

9371 TCAGAACATCAAGCACCGCC<sub>9390</sub> (SEQ ID NO:16)

9741 ACAGTCAAGACTGAGATGAG<sub>9760</sub> (SEQ ID NO:17)

10001 AAGAGTCAGATACATGTGGA<sub>10020</sub> (SEQ ID NO:18)

15

10351 ACATGAATCAGCCTAAAGTC<sub>10370</sub> (SEQ ID NO:19)

10674 CCGAAAGAGTTCCTGCGTTACGACC<sub>10698</sub> (SEQ ID NO:20)

11083 CAGTCCACACAAGTACCAGG<sub>11102</sub> (SEQ ID NO:21)

11461 GTCAGAAGCTGTGGACCATC<sub>11480</sub> (SEQ ID NO:22)

11841 AATATTGCTACAACAATGGC<sub>11860</sub> (SEQ ID NO:23)

20

12196 ACTCTTCATTCTAGACTGG<sub>12215</sub> (SEQ ID NO:24)

12542 GTCCAATTATGACTATGAAC<sub>12561</sub> (SEQ ID NO:25)

12891 AGAACAGACATGAAGCTTGC<sub>12910</sub> (SEQ ID NO:26)

13232 CCAACAAGGAATGCTTCTAG<sub>13251</sub> (SEQ ID NO:27)

13551 ACAGCACTATCTATGATTGACCTGG<sub>13575</sub> (SEQ ID NO:28)

25

13930 GCAACATGGTTTACACATGC<sub>13949</sub> (SEQ ID NO:29)

14280 AGATTGAGAGTTGATCCAGG<sub>14299</sub> (SEQ ID NO:30)

14629 AGGAGATACTTAAACTAAGC<sub>14648</sub> (SEQ ID NO:31)

14981 TAAGCTTATGCCTTTCAGCG<sub>15000</sub> (SEQ ID NO:32)

15337 TTAACGGACCTAAGCTGTGC<sub>15356</sub> (SEQ ID NO:33)

30

15671 GAAACAGATTATTATGACGG<sub>15690</sub> (SEQ ID NO:34)

9290 CGGGCTATCTAGGTGAACTTCAGG<sub>9267</sub> (SEQ ID NO:35)

9500 ATTTGGATATGGAATATGAG<sub>9481</sub> (SEQ ID NO:36)

9840 ACTCAACTGAACTACCACTG<sub>9821</sub> (SEQ ID NO:37)

35

10181 AAGAACATCATGTATTTTCAG<sub>10162</sub> (SEQ ID NO:38)

- 52 -

10549 TTATCAACGCACTGCTCATG<sub>10530</sub> (SEQ ID NO:39)  
 10919 ATTTTCAGCAATCACTTGGCATGCC<sub>10895</sub> (SEQ ID NO:40)  
 11280 GCCTCTGTGCAAACAAGCTG<sub>11261</sub> (SEQ ID NO:41)  
 11638 TCTCTAGTTACTCTAGCAGC<sub>11619</sub> (SEQ ID NO:42)  
 5 12010 AGGTCGTTGTTTGTGAGGAG<sub>11991</sub> (SEQ ID NO:43)  
 12361 TCGTCCTCTTCTTTACTGTC<sub>12342</sub> (SEQ ID NO:44)  
 12689 CCGTCCTCGAGCTAGCCTCG<sub>12670</sub> (SEQ ID NO:45)  
 13052 CTCCTCCAGGCTCACATTGG<sub>13033</sub> (SEQ ID NO:46)  
 13420 GGGTTGGTACATAGCTCTGC<sub>13401</sub> (SEQ ID NO:47)  
 10 13767 CACCCATCTGATATTTCCCTGATGG<sub>13743</sub> (SEQ ID NO:48)  
 14099 TGGTTGACAGTACAAATCTG<sub>14080</sub> (SEQ ID NO:49)  
 14460 CTGAAATGGGAAGATTGTGC<sub>14441</sub> (SEQ ID NO:50)  
 14820 AGCAATCTACACTGCCTACC<sub>14801</sub> (SEQ ID NO:51)  
 15180 TCACAGATGATTCAATTATC<sub>15161</sub> (SEQ ID NO:52)  
 15 15530 GATCCTAGATATAAGTTCTC<sub>15511</sub> (SEQ ID NO:53)  
  
 1 ACCAAACAAAGTTGGGTAAGG<sub>21</sub> (SEQ ID NO:54)  
 GGGGGATCC<sub>100</sub>ATCCCTAATCCTGCTCTTGTCCC<sub>78</sub> (SEQ ID NO:55)  
 200 GATTCCTCTGATGGCTCCAC<sub>181</sub> (SEQ ID NO:56)  
 20 15721 TAACAGTCAAGGAGACCAAAG<sub>15741</sub> (SEQ ID NO:57)  
 GGGGAAGCTT<sub>15801</sub>AACCCTAATCCTGCCCTAGGTGG<sub>15823</sub> (SEQ ID NO:58)  
 15894 ACCAGACAAAGCTGGGAATAGA<sub>15873</sub> (SEQ ID NO:59)

25 Overlapping PCR fragments of the complete  
 viral genome were directly sequenced without cloning to  
 achieve the consensus sequence, by the dideoxy  
 terminator cycle sequencing method using both strands  
 (ABI PRISM 377 sequencer and ABI PRISM sequencing Kit).  
 To determine the sequence at the absolute termini, a  
 30 ligation procedure described previously was used (56).

The nucleotide sequences were determined for  
 regions other than the genomic promoter region and the  
 L gene of the progenitor Edmonston wild-type MV  
 isolate, for the available vaccine strains derived from  
 35 this isolate, as well as for other wild-type strains.

- 53 -

Significant nucleotide (in antigenomic, message sense) and amino acid differences were then compared and aligned as set forth in Tables 3-5 (differences are in *italics*):

5

Table 3

Differences in MV N Nucleotides and Amino Acids  
Between Edmonston Wild-Type and Vaccine Strains

10

<u>Nucleotide</u>	<u>275</u>	<u>492</u>	<u>550</u>	<u>623</u>	<u>1542</u>
-------------------	------------	------------	------------	------------	-------------

Edmonston w-t	GTC	CAA	GAG	GCC	TCG
---------------	-----	-----	-----	-----	-----

Mutation	GTG	AAA	GGG	GCT	ACG
----------	-----	-----	-----	-----	-----

15

<u>Amino Acid</u>	<u>56</u>	<u>129</u>	<u>148</u>	<u>172</u>	<u>479</u>
-------------------	-----------	------------	------------	------------	------------

Edmonston w-t	V	Q	E	A	S
---------------	---	---	---	---	---

Rubeovax™ vac.	V	Q	E	A	T
----------------	---	---	---	---	---

20

Moraten vac.	V	Q	G	A	T
--------------	---	---	---	---	---

Schwarz vac.	V	Q	G	A	T
--------------	---	---	---	---	---

Zagreb vac.	V	Q	E	A	S
-------------	---	---	---	---	---

AIK-C vac.	V	K	E	A	S
------------	---	---	---	---	---

25

- 54 -

Table 4  
Differences in MV P and C Nucleotides and Amino Acids  
Between Wild-Type and Vaccine Strains

<u>Gene</u>	<u>C</u>	<u>C</u>	<u>C</u>	<u>P*</u>	<u>P</u>	<u>P</u>
<u>Nucleotide</u>	<u>2046</u>	<u>2139</u>	<u>2229</u>	<u>2480</u>	<u>2630</u>	<u>3122</u>
Edmonston w-t	GCC	ATG	TCT	GAG	TGT	CTA
Mutation	GTC	ACG	TAT	GGG	TAT	CCA
<u>Amino Acid</u>	<u>73</u>	<u>104</u>	<u>134</u>	<u>225</u>	<u>275</u>	<u>439</u>
Edmonston w-t	A	M	S	E	C	L
1977 w-t	V	M	S	E	C	L
1983 w-t	V	M	S	E	C	L
Montefiore w-t	V	M	S	E	C	L
Rubeovax™ vac.	V	T	S	G	C	L
Moraten vac.	V	T	S	G	C	L
Schwarz vac.	V	T	S	G	C	L
Zagreb vac.	V	M	S	G	C	L
AIK-C vac.	V	M	Y	G	Y	P

\* Identical change in V protein

- 55 -

Table 5  
Differences in MV F Gene-End Signal Between  
Edmonston Wild-Type and Vaccine Strains

Nucleotides 7237-7247

Edmonston w-t	G T T A A T T A A A A
Rubeovax™ vac.	G T T A A T T A A A A
Moraten vac.	G T T A A T C A A A A
Schwarz vac.	G T T A A T C A A A A
Zagreb vac.	G T T A A T T A A A A
AIK-C vac.	G T T A A T T A A A A

↑

7243

- 56 -

Example 2  
RSV Subgroup B

5       The temperature-sensitive (*ts*) phenotype is  
strongly associated with attenuation *in vivo*; in  
addition, some non-*ts* mutations may also be  
attenuating. Identification of *ts* and non-*ts*  
attenuating mutations was achieved by sequence analysis  
and evaluation of *ts*, cold-adapted (*ca*), and *in vivo*  
10       growth phenotypes of RSV mutants and revertants.

      The genomes of the following three RSV 2B  
strains have been completely sequenced: The 2B wild-  
type parent, a *ts* and *ca* derivative thereof designated  
2B33F and one *ts*(+) revertant designated 2B33F TS(+).  
15       The 2B33F strain is described in U.S. Serial No.  
08/059,444 (88), which is hereby incorporated by  
reference. After identifying regions where mutations  
in 2B33F are located, nine additional isolates of 2B33F  
"revertants" obtained following *in vitro* passaging at  
20       39°C and *in vivo* passaging in African green monkeys or  
chimpanzees have been sequenced in those previously-  
identified mutant regions. The *ts*, *ca*, and attenuation  
phenotypes of many of these revertants have now been  
characterized and assessed. Correlations between *ts*  
25       phenotype, virus attenuation and sequence changes have  
been identified.

      A summary of results is presented in Tables  
6-11.

- 57 -

Table 6  
Sequence comparison between RSV 2B and 2B33F strains

Gene/ region	Nucl. pos.†	Nucleotide changes			Amino acid changes
	3' end of vRNA	RSV 2B	RSV 2B33F	RSV 2B33F TS(+), 5a revertant	
Genomic Promoter	4 6	C -	G extra A	G extra A	non-coding non-coding
M	4175 4199	T T	C C	C C	non-coding non-coding
SH	4329 4409 4420 4442 4454 4484 4497 4505 4525 4526 4542 4561 4575 4598	T T T T T T T T T T T T T T	C C C C C C C C C C C C C C	C C C C C C C C C C C C C C	Phe-Leu (10) none Ile (36) Ile-Thr (40) none His (47) none Cys (51) none Tyr (61) Stop-Gln (66) none Ser (68) Ile-Thr (75) Ile-Thr (75) Stop-Gln (81) Leu-Pro (87) Trp-Arg (92) none Thr (99)
L	9559 9853* 12186 14587 15071	G A G C A	A G A T G	A A A T G	Arg-Lys (353) Lys-Arg (451)* Asp-Asn (1229) Thr-Ile (2029) non-coding

† For 2B33F and 2B33F TS(+), nucl. pos. numbers are one larger than for 2B for M, SH & L genes

\* At pos. 9853, the Lys-Arg change has reverted back to Lys in the 2B33F TS(+) strain



- 58 -

Table 7  
Differences in M Gene-End Signal Between  
RSV 2B and 2B33F strains

	<u>Nucleotide Numbers</u>	<u>Nucleotide Sequence</u>
2B	4196-4207	A G G T A A A T A A A A
2B33F	4197-4208	A G G C A A A T A A A A
2B33F TS(+)	4197-4208	A G G C A A A T A A A A

↑

Table 8  
RSV 2B, *ts* and Revertant Strains

Sample	Source	In Vitro Phenotype		In Vivo Growth*			
		<i>ts</i>	<i>ca</i>	Cotton Rat	AGM		
		39/32°C ROP plaque morph	20/32°C Yield	Nasal turbينات	Lungs	Nasal Wash	Bronchial Lavage
RSV 2B	Wild-type Parent Strain	0.7 (WT)	0.0001	5.5 <sup>a</sup> 3.9 <sup>b</sup> (4/4)	5.8 <sup>a</sup> 5.2 <sup>b</sup> (4/4)	5.8 <sup>a</sup> (4/4)	4.7 <sup>a</sup> (4/4)
RSV 2B33F	<i>ca</i> , <i>ts</i> mutant isolated from 2B cold-passaged x 33	0.00007 (sp,int/wt)	0.04	≤1.6 <sup>a</sup> <1.9 <sup>b</sup> (1/4)	<1.5 <sup>a</sup> <1.2 <sup>b</sup> (0/4)	3.0 <sup>a</sup> (4/4)	<0.9 <sup>a</sup> (0/4)
RSV 2B33F - 5a TS(+)	2B33F spinner passage, plaque picked at 39°C	0.5 (WT)	0.03	≤1.7 <sup>a</sup> (1/4)	3.5 <sup>a</sup> (4/4)	4.2 <sup>a</sup> (4/4)	4.0 <sup>a</sup> (4/4)
RSV 2B33F - 4a TS(+)	2B33F spinner passage, plaque picked at 39°C	0.7 (WT)	0.01	≤1.7 <sup>a</sup> (3/4)	3.8 <sup>a</sup> (4/4)	ND	ND
RSV 2B33F - 3b TS(+)	2B33F spinner passage, plaque picked at 39°C	0.5 (WT)	0.04	≤2.5 <sup>a</sup> (3/4)	2.9 <sup>a</sup> (4/4)	ND	ND
AGM pp2	2B33F-infected AGM #A2,d7 nasal wash plaque picked at 32°C	0.3 (sp,int)	0.00002	≤2.0 <sup>b</sup> (1/4)	1.6 <sup>b</sup> (4/4)	ND	ND
AGM pp4	2B33F-infected AGM #A2,d7 nasal wash plaque picked at 32°C	0.1 (sp,int)	0.008	<1.6 <sup>b</sup> (0/4)	1.2 <sup>b</sup> (4/4)	ND	ND

Table 8 (continued)  
RSV 2B, ts and Revertant Strains

Sample	Source	In Vitro Phenotype ts		In Vivo Growth* Cotton Rat			
		39/32°C EOP plaque morph	20/32°C Yield	Nasal turbينات	Lungs	Nasal Wash	Bronchial Lavage
AGM pp6	2B33F-infected AGM #A4, d12 nasal wash plaque picked at 32°C	0.000004 (WT)	≤ 0.00005	≤ 1.5 <sup>b</sup> (1/4)	< 1.1 <sup>b</sup> (0/4)	ND	ND
AGM pp7	2B33F-infected AGM #A4, d12 nasal wash plaque picked at 32°C	0.000004 (sp/int/wt)	0.007	≤ 1.4 <sup>b</sup> (1/4)	< 1.0 <sup>b</sup> (0/4)	ND	ND
Chimp pplA	2B33F-infected Chimp #1552, d4 tracheal lavage plaque picked at 32°C	0.5 (WT)	ND	ND	ND	ND	ND
Chimp pp3A	2B33F-infected Chimp #1560, d6 tracheal lavage plaque picked at 32°C	0.7 (WT)	ND	2.4 <sup>c</sup> (4/4)	≤ 3.0 <sup>c</sup> (3/4)	ND	ND
Chimp pp5A	2B33F-infected Chimp #1563, d10 nasal swab plaque picked at 32°C	0.7 (WT)	ND	≤ 2.3 <sup>c</sup> (3/4)	3.0 <sup>c</sup> (4/4)	ND	ND

\* In Vivo growth measured in log<sub>10</sub> mean virus titer (# infected/# total)

ND = not done WT = wild-type plaque size sp = small plaque size int = intermediate plaque size

<sup>a</sup> Dose = 10<sup>6.7</sup> PFU IN<sup>b</sup> Dose = 10<sup>5.6</sup> PFU IN<sup>c</sup> Dose = 10<sup>6.3</sup> PFU IN

<sup>d</sup> Dose = 10<sup>5.9</sup> PFU IN<sup>e</sup> Dose = 10<sup>6.6</sup> PFU IN+IT<sup>f</sup> Dose = 10<sup>6.0</sup> PFU IN+IT

- 61 -

Table 9  
2B33F Revertants

	<i>ts</i> (+) <i>In vitro</i>			AGM				Chimp		
	5a	4a	3b	pp2	pp4	pp6	pp7	1A	3A	5A
base no.†										
<u>M</u>										
4176,4200	S	S	S	S	S	S	S	S	S	S
<u>SH</u>										
14 bases*	S	S	S	S	S	S	S	S	S	S
<u>L</u>										
9560	S	S	S	S	S	S	S	S	S	S
9854	2B	2B	2B	S	S	S	S	2B	2B	2B
12187	S	S	S	S	S	S	S	S	S	S
14588	S	S	S	S	S	S	S	S	S	S
15072	S	S	S	S	S	S	S	S	S	S
Phenotype										
<i>ts</i>	2B	2B	2B	r	r	S	S	2B	2B	2B
<i>ca</i>	S	S	S	2B	S	2B	S	ND	ND	ND
Attenuated	r	r	r	(r)	(r)	S	S	ND	r	r

† These 2B33F revertant base nos. are one larger than for 2B for M, SH and L genes

\* bases 4330,4410,4421,4443,4455,4485,4498,4506,4526,4527,4543, 4562,4576,4599

S = same base as 2B33F

2B = reversion to 2B base or complete reversion in phenotype

r = moderate reversion in phenotype

(r) = slight reversion in phenotype

ND = not done

- 62 -

Table 10  
RSV 2B, *ts* and Revertant Strains: Phenotype Summary

Virus Isolate	Source	In Vitro Phenotype		In Vivo Attenuation	
		<i>ts</i>	<i>ca</i>	Cotton Rat	AGM
RSV 2B	Wild-type Parent Strain	-	-	-	-
RSV 2B33F	<i>ca</i> , <i>ts</i> mutant isolated from 2B, cold-passaged x 33	++++	++	++++	+++
RSV 2B33F - 5a TS(+)	2B33F spinner passage plaque picked at 39°C	-	++	++	+
RSV 2B33F - 4a TS(+)	2B33F spinner passage plaque picked at 39°C	-	++	++	ND
RSV 2B33F - 3b TS(+)	2B33F spinner passage plaque picked at 39°C	-	++	++	ND
AGM pp2	2B33F-infected AGM A2, d7 nasal wash plaque picked at 32°C	+	-	+++	ND
AGM pp4	2B33F-infected AGM A2, d7 nasal wash plaque picked at 32°C	+	++	+++	ND
AGM pp6	2B33F-infected AGM A4, d12 nasal wash plaque picked at 32°C	++++	-	++++	ND
AGM pp7	2B33F-infected AGM A4, d12 nasal wash plaque picked at 32°C	++++	++	++++	ND
Chimp pplA	2B33F-infected chimp #1552, d4 tracheal lavage, plaque picked at 32°C	-	ND	ND	ND
Chimp pp3A	2B33F-infected chimp #1560, d6 tracheal lavage, plaque picked at 32°C	-	ND	++	ND
Chimp pp5A	2B33F-infected chimp #1563, d10 tracheal lavage, plaque picked at 32°C	-	ND	++	ND

ND = not done

- = wild-type phenotype, i.e., not temperature sensitive, not cold adapted, not attenuated

+ to ++++ = increasing levels of temperature sensitivity, cold-adaptation or attenuation

- 63 -

Northern blot analysis of poly (A)+ RNA isolated from RSV-infected Vero cells was performed using a mixture of <sup>32</sup>P-labelled riboprobes specific for the M gene of RSV subgroup A and B viruses to determine the effect of the M gene-end signal sequences on M gene transcription. The negative sense hybridization probes were T7 RNA polymerase transcripts synthesized *in vitro* from PCR products containing the T7 promoter sequence. As shown in Figure 4, Northern blot analysis using M gene probes depicted abundant monocistronic M gene transcripts for RSV subgroup A viruses, whereas bicistronic M:SH transcripts were predominant for subgroup B viruses. Bicistronic M:SH transcripts are likely to be constrained in their ability to translate the SH gene and thus represent a potential means for controlling viral SH gene expression. The 2B33F mutant (lane 5) and 2B33F TS(+) revertant (lane 6) strains produced practically no monocistronic M transcripts; the bulk of their transcription products were bicistronic and higher molecular weight read-through transcripts. Thus, these two strains have essentially stopped producing the SH protein.

In contrast, the wild-type subgroup B strains 2B, B1 and 18537 produced a slight excess of bicistronic over monocistronic mRNAs (lanes 3, 4, 7). The subgroup A 3A virus showed comparable levels of monocistronic and bicistronic products (lane 1). At the other extreme from what was observed for the 2B mutant strains was the M gene transcription pattern of the A2 virus (lane 2). For this strain, monocistronic M transcripts were produced in abundance, while read-through transcription was minimal.

Northern blot results were confirmed by a ribonuclease protection assay which was performed on the same poly (A)+ RNA that was used for the Northern

- 64 -

blot, in order to assess the ratio of monocistronic M and SH mRNAs to bicistronic M:SH for each RSV subgroup B virus. Riboprobes were used which were negative sense virus-specific  $^{32}\text{P}$ -labelled transcripts of 284 nucleotides in length (B viruses) that spanned the M:SH gene junction. The full-length probe should be protected from RNase digestion predominantly by bicistronic M:SH transcripts. Monocistronic M and SH transcripts are expected to protect approximately 165 and 110 nucleotide probe fragments, respectively, from RNase digestion.

In an assay for 2B, 2B33F, and 2B33F TS(+) viral RNA shown in Figure 5, viral RNA or control yeast RNA was hybridized with  $5 \times 10^4$  cpm of probe; thereafter, the hybridized RNA was then digested with RNase T1 (diluted 1:100), precipitated with ethanol, and the protected probe fragments were separated on a denaturing 6% polyacrylamide gel.

Results of this ribonuclease protection assay are depicted in Figure 5. In this assay, the signal intensity of the protected probe fragment corresponding to bicistronic M:SH relative to that of monocistronic M for each virus was in agreement with the results obtained by Northern blotting with the M gene probes, that is, greater monocistronic signal for 2B and practically no monocistronic signal for 2B33F and 2B33F TS(+) (Fig. 5).

To evaluate the influence of the M gene-end signal on expression of the downstream SH gene, Northern blot analysis of poly (A)+ RNA of the RSV viruses was performed using negative sense  $^{32}\text{P}$ -labelled riboprobes specific for the SH gene of an RSV subgroup A and B strain to appraise the influence of the M GE signal on expression of the downstream SH gene (see Figure 6). The pattern of SH gene transcripts produced

- 65 -

by each virus, that is, the level of monocistronic SH to bicistronic M:SH, was comparable to that observed for the M gene transcription products. Those RSV viruses that were inefficient in terminating M gene transcription at the M gene-end signal were also compromised in the synthesis of monocistronic SH transcripts. The 2B33F mutant and its TS(+) revertant synthesized practically no monocistronic product, but accumulated abundant M:SH transcripts. The wild-type 3A, 2B, B1 and 18537 viruses accumulated comparable levels of both transcription products, while the A2 strain produced monocistronic SH mRNA as the most abundant product of SH gene transcription. The transcripts identified by Northern blot analysis were quantitated by phosphorimager analysis and a relative ratio of monocistronic SH to bicistronic M:SH was determined for each virus. As shown in Table 11, the ratios ranged from 0.23 to 11.1, with the lowest values observed for the RSV subgroup B strains containing the mutation at the fourth nucleotide (T → C) of the M gene-end signal:

Table 11  
Ratio of Monocistronic SH to Bicistronic M:SH  
Transcripts in RSV Subgroup A and B Strains

<u>Virus</u>	<u>SH/M:SH</u>
2B	1.4
2B33F	0.23
2B33F TS(+)	0.29
B1	1.0
18537	0.76
A2	11.1
3A	2.2



- 66 -

Several significant observations can be drawn from these data: As shown in Table 6, there are relatively few sequence changes identified in the mutant strain: RSV 2B33F differs from parental RSV 2B by two changes at the 3' genomic promoter region, two changes at the non-coding 5'-end of the M gene, including one in the M gene-end signal, and four coding changes plus one non-coding (poly(A) motif) change in the RNA dependent RNA polymerase coding L gene. In addition, 14 changes mapped to the SH gene alone.

An attenuating mutation can be identified in the M gene-end signal of the attenuated virus strain 2B33F: The shift from a slight excess of bicistronic over monocistronic mRNAs in the wild-type 2B strain to the predominance of bicistronic transcription products in the 2B33F vaccine strain and the 2B33F TS(+) revertant strain provides evidence that the mutation in the M gene-end signal contributes to the attenuation phenotype of these latter two viral strains.

- 67 -

Bibliography

1. Kapikian, A.Z., et al., Am. J. Epidemiol., 89, 405-421 (1969).
2. Chin, J., et al., Am. J. Epidemiol., 89, 449-463 (1969).
3. Fulginiti, V.A., et al., Am. J. Epidemiol., 89, 435-448 (1969).
4. Prince, G.A., et al., J. Virology, 57, 721-728 (1986).
5. Kim, H.W., et al., Pediatrics, 52, 56-63 (1973).
6. Hodes, D.S., et al., Proc. Soc. Exp. Biol. Med., 145, 1158-1164 (1974).
7. Belshe, R.B., and Hissom, F.K., J. Med. Virol., 10, 235-242 (1982).
8. Black, F.L., et al., Am. J. Epidemiol., 124, 442-452 (1986).
9. Lennon, J.L., and Black, F.L., J. Pediatrics, 108, 671-676 (1986).
10. Pabst, H.F., et al., Pediatr. Infect. Dis. J., 11, 525-529 (1992).
11. Centers for Disease Control, MMWR, 40, 369-372 (1991).
12. Centers for Disease Control, MMWR, 41:S6, 1-12 (1992).
13. King, G.E., et al., Pediatr. Infect. Dis. J., 10, 883-887 (1991).
14. Rota, J.S., et al., Virology, 188, 135-142 (1992).
15. Rota, J.S., et al., Virus Res., 31, 317-330 (1994).
16. Lamb, R.A., and Kolakosky, D., pages 1177-1204 of Volume 1, Fields Virology, B.N. Fields, et al., Eds. (3rd ed., Raven Press, 1996).

- 68 -

17. Sidhu, M.S., et al., Virology, 193, 50-65 (1993).
18. Garcin, D., et al., EMBO J., 14, 6087-6094 (1995).
19. Radecke, F., et al., EMBO J., 14, 5773-5783 (1995).
20. Collins, P.L., et al., Proc. Natl. Acad. Sci., USA, 92, 11563-11567 (1995).
21. U.S. Provisional Patent Application No. 60/047575.
22. Published European Patent Application No. 702,085.
23. Baron, M.D., and Barrett, T., J. Virology, 71, 1265-1271 (1997).
24. Published International Application No. WO 97/06270.
25. Published International Application No. WO 97/12032.
26. Kato, A., et al., Genes to Cells, 1, 569-579 (1996).
27. Sidhu, M.S., et al., Virology, 208, 800-807 (1995).
28. Shaffer, M.F., et al., J. Immunol., 41, 241-256 (1941).
29. Enders, J.F., et al., N. Engl. J. Med., 263, 153-159 (1960).
30. Crowe, J.E., et al., J. Inf. Dis., 173, 829-839 (1996).
31. Crowe, J.E., et al., Vaccine, 12, 783-790 (1994).
32. Enders, J.F., and Peebles, M.E., Proc. Soc. Exp. Biol. Med., 86, 227-286 (1954).
33. Schwarz, A.J.F., Am. J. Dis. Child., 103, 216-219 (1962).

- 69 -

34. Griffin, D.E., and Bellini, W.J., pages 1267-1312 of Volume 1, Fields Virology, B.N. Fields, et al., Eds. (3rd ed., Raven Press, 1996).
35. Birrer, M.J., et al., Virology, 108, 381-390 (1981).
36. Birrer, M.J., et al., Nature, 293, 67-69 (1981).
37. Norby, E., et al., pages 481-507, in The Paramyxoviruses, D. Kingsbury, Ed. (Plenum Press, 1991).
38. Peebles, M.E., pages 427-456, in The Paramyxoviruses, D. Kingsbury, Ed. (Plenum Press, 1991).
39. Egelman, E.H., et al., J. Virol., 63, 2233-2243 (1989).
40. Udem, S.A., et al., J. Virol. Methods, 8, 123-136 (1984).
41. Udem, S.A., and Cook, K.A., J. Virol., 49, 57-65 (1984).
42. Moyer, S.A., and Horikami, S.M., pages 249-274, in The Paramyxoviruses, D. Kingsbury, Ed. (Plenum Press, 1991).
43. Blumberg, B., et al., pages 235-247, in The Paramyxoviruses, D. Kingsbury, Ed. (Plenum Press, 1991).
44. Berrett, T., et al., pages 83-102, in The Paramyxoviruses, D. Kingsbury, Ed. (Plenum Press, 1991).
45. Tordo, N., et al., Sem. in Virology, 3, 341-357 (1992).
46. Cattaneo, R., et al., EMBO J., 6, 681-688 (1987).
47. Crowley, J.C., et al., Virology, 164, 498-506 (1988).

- 70 -

48. Banerjee, A.K., and Barik, S., et al., Virology, 188, 417-428 (1992).
49. Castaneda, S.J., and Wong, T.C., J. Virol., 63, 2977-2986 (1989).
50. Chan, J., et al., pages 221-231, in Genetics and Pathogenicity of Negative Stranded Viruses, B.W.J. Mahy and D. Kolakofsky, Eds. (Elsevier Biomedical Press, 1989).
51. Blumberg, B., et al., Cell, 23, 837-845 (1981).
52. Blumberg, B., et al., Cell, 32, 559-567 (1983).
53. Kolakofsky, D., and Blumberg, B.M., pages 203-213, in Virus Persistence, B.M.J. Mahy, et al., Eds. (Cambridge University Press, 1982).
54. Castaneda, S.J., and Wong, T.C., J. Virol., 64, 222-230 (1990).
55. Curran, J.A., and Kolakofsky, D., Virology, 182, 168-176 (1991).
56. Sidhu, M.S., et al., Virology, 193, 66-72 (1993).
57. Sidhu, M.S., et al., Virology, 202, 631-641 (1994).
58. Baron, M.D., et al., J. Gen. Virol., 77, 3041-3046 (1996).
59. Firestone, C-Y, et al., Virology, 225, 419-422 (1996).
60. Bankamp, B., et al., Virology, 216, 272-277 (1996).
61. Sinitsyna, O.A., et al., Res. Virol., 141, 517-531 (1990).
62. Whitehead, S.S., et al., In Press (1998).
63. Anderson, L.J., et al., J. Infect. Dis., 151, 626-633 (1985).

- 71 -

64. Collins, P.L., pages 103-162 of The Paramyxoviruses, D.W. Kingsbury, Ed. (Plenum Press, NY and London, 1991).
65. Sullender, W.M., J. Virology, 65, 5425-5434 (1991).
66. Lerch, R.A., et al., J. Virology, 64, 5559-5569 (1990).
67. Mallipeddi, S.K., and Samal, S.K., J. Gen. Virol., 74, 2787-2791 (1993).
68. Johnson, P.R., et al., J. Virology, 61, 3163-3166 (1987).
69. Stott, E.J., et al., J. Virology, 61, 3855-3861 (1987).
70. Henderson, F.W., et al., N. Engl. J. Med., 300, 530-534 (1979).
71. Hall, S.L., et al., J. Infect. Dis., 163, 693-698 (1991).
72. Mufson, M.A., et al., J. Gen. Virol., 66, 2111-2124 (1985).
73. Glezen, W.P., et al., Am. J. Dis. Child., 140, 543-546 (1986).
74. Hemming, V.G., et al., Clin. Microbiol. Res., 8, 22-33 (1995).
75. Collins, P. L. et. al., pages 1313-1351 of volume 1, Fields Virology, B. N. Fields, et al., Eds. (3rd ed., Raven Press, 1996).
76. Ling, R., and Pringle, C.R., J. Gen. Virol., 70, 1427-1440 (1989).
77. Yu, Q., et al., J. Virology, 69, 2412-2419 (1995).
78. McIntosh, K., and Chanock, R.M., pages 1045-1072 of Virology, B.N. Fields, et al., Eds. (2nd ed., Raven Press, 1990).

- 72 -

79. Heminway, B.R., et al., page 167 of Abstracts of the IX International Congress of Virology, P17-2, (1993).

80. Mink, M.A., et al., Virology, 185, 615-624 (1991).

81. Dickens, L.E., et al., J. Virology., 52, 364-369 (1990).

82. Wagner, R.R., and Rose, J.K., pages 1121-1135 of volume 1, Fields Virology, B.N. Fields, et al., Eds. (3rd ed., Raven Press, 1996).

83. Barik, S., J. Gen. Virol., 74, 485-490 (1993).

84. Collins, P.L., et al., pages 259-264 of Vaccines 93: modern approaches to new vaccines including prevention of AIDS, F. Brown et al., Eds. (Cold Spring Harbor Laboratory Press, NY, 1993).

85. Kuo, L., et al., J. Virology., 70, 6892-6901 (1996).

86. Huang, Y.T., and Wertz, G.W., J. Virology, 43, 150-157 (1982).

87. Sambrook, J., et al., Molecular Cloning: A Laboratory Manual, 2nd ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989).

88. U.S. Patent Application No. 08/059,444.

- 73 -

What is claimed is:

1. An isolated, recombinantly-generated, attenuated measles virus having one or more attenuating mutations selected from the group consisting of:

- (a) for the N gene, nucleotide changes which produce changes in an amino acid selected from the group consisting of residues 129 (glutamine → lysine), 148 (glutamic acid → glycine) and 479 (serine → threonine);
- (b) for the P gene, nucleotide changes which produce changes in an amino acid selected from the group consisting of residues 225 (glutamic acid → glycine), 275 (cysteine → tyrosine) and 439 (leucine → proline);
- (c) for the C gene, nucleotide changes which produce changes in an amino acid selected from the group consisting of residues 73 (alanine → valine), 104 (methionine → threonine) and 134 (serine → tyrosine); and
- (d) for the F gene-end signal, the change at nucleotide 7243 (T → C), where these nucleotides are presented in positive strand, antigenomic, message sense.

2. The measles virus of Claim 1 which further comprises:

- (a) at least one attenuating mutation in the 3' genomic promoter region selected from the group consisting of nucleotide 26 (A → T), nucleotide 42 (A → T or A → C) and nucleotide 96 (G → A), where these



- 74 -

- nucleotides are presented in positive strand, antigenomic, message sense; and
- (b) at least one attenuating mutation in the RNA polymerase gene selected from the group consisting of nucleotide changes which produce changes in an amino acid selected from the group consisting of residues 331 (isoleucine → threonine), 1409 (alanine → threonine), 1624 (threonine → alanine), 1649 (arginine → methionine), 1717 (aspartic acid → alanine), 1936 (histidine → tyrosine), 2074 (glutamine → arginine) and 2114 (arginine → lysine).

3. An isolated, recombinantly-generated, attenuated human respiratory syncytial virus (RSV) subgroup B having an attenuating mutation in the M gene-end signal at nucleotide 4199 (T → C), where these nucleotides are presented in positive strand, antigenomic, message sense.

4. The RSV subgroup B of Claim 3 which further comprises:

- (a) at least one attenuating mutation in the 3' genomic promoter region selected from the group consisting of nucleotide 4 (C → G) and the insertion of an additional A in the stretch of A's at nucleotides 6-11, where these nucleotides are presented in positive strand, antigenomic, message sense; and
- (b) at least one attenuating mutation in the RNA polymerase gene selected from the group consisting of nucleotide changes which produce changes in an amino acid

- 75 -

selected from the group consisting of residues 353 (arginine → lysine), 451 (lysine → arginine), 1229 (aspartic acid → asparagine), 2029 (threonine → isoleucine) and 2050 (asparagine → aspartic acid).

5. The RSV subgroup B of Claim 4 which includes the insertion of an additional A in the stretch of A's at nucleotides 6-11, such that the attenuating mutation in the M gene-end signal (T → C) is at nucleotide 4200, where these nucleotides are presented in positive strand, antigenomic, message sense.

6. A vaccine comprising an isolated, recombinantly-generated, attenuated measles virus according to Claim 1 and a physiologically acceptable carrier.

7. The vaccine of Claim 6 comprising a measles virus according to Claim 2 and a physiologically acceptable carrier.

8. A vaccine comprising an isolated, recombinantly-generated, attenuated RSV subgroup B according to Claim 3 and a physiologically acceptable carrier.

9. The vaccine of Claim 8 comprising an RSV subgroup B according to Claim 4 and a physiologically acceptable carrier.

10. The vaccine of Claim 8 comprising an RSV subgroup B according to Claim 5 and a physiologically acceptable carrier.

11. A method for immunizing an individual to induce protection against measles virus which comprises administering to the individual the vaccine of Claim 6.

- 76 -

12. The method of Claim 11 wherein the vaccine is the vaccine of Claim 7.

13. A method for immunizing an individual to induce protection against RSV subgroup B which comprises administering to the individual the vaccine of Claim 8.

14. The method of Claim 13 wherein the vaccine is the vaccine of Claim 9.

15. The method of Claim 13 wherein the vaccine is the vaccine of Claim 10.

16. A composition which comprises a transcription vector comprising an isolated nucleic acid molecule encoding a genome or antigenome of a measles virus according to Claim 1, together with at least one expression vector which comprises at least one isolated nucleic acid molecule encoding the trans-acting proteins N, P and L necessary for encapsidation, transcription and replication, whereby upon expression an infectious attenuated virus is produced.

17. The composition of Claim 16 wherein the transcription vector comprises an isolated nucleic acid molecule which encodes a measles virus according to Claim 2.

18. A composition which comprises a transcription vector comprising an isolated nucleic acid molecule encoding a genome or antigenome of an RSV subgroup B according to Claim 3, together with at least one expression vector which comprises at least one isolated nucleic acid molecule encoding the trans-acting proteins N, P, L and M2 necessary for encapsidation, transcription and replication, whereby upon expression an infectious attenuated RSV subgroup B is produced.

- 77 -

19. The composition of Claim 18 wherein the transcription vector comprises an isolated nucleic acid molecule which encodes an RSV subgroup B according to Claim 4.

20. The composition of Claim 18 wherein the transcription vector comprises an isolated nucleic acid molecule which encodes an RSV subgroup B according to Claim 5.

21. A method for producing infectious attenuated measles virus which comprises transforming or transfecting host cells with the at least two vectors of Claim 16 and culturing the host cells under conditions which permit the co-expression of these vectors so as to produce the infectious attenuated measles virus.

22. The method of Claim 21 wherein the virus is the measles virus of Claim 2.

23. A method for producing infectious attenuated RSV subgroup B which comprises transforming or transfecting host cells with the at least two vectors of Claim 18 and culturing the host cells under conditions which permit the co-expression of these vectors so as to produce the infectious attenuated RSV subgroup B.

24. The method of Claim 23 wherein the virus is the RSV subgroup B of Claim 4.

25. The method of Claim 23 wherein the virus is the RSV subgroup B of Claim 5.

1/6

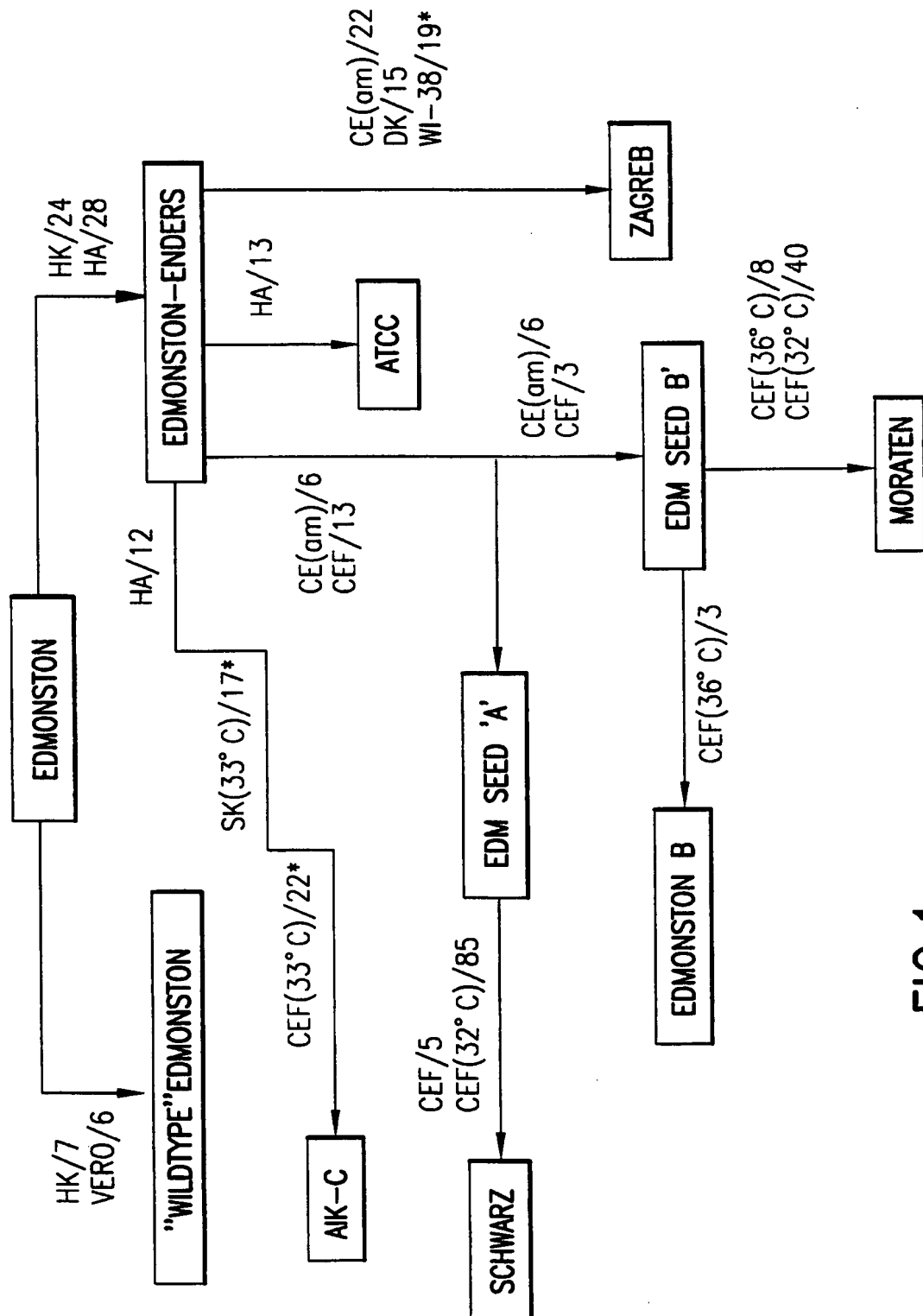
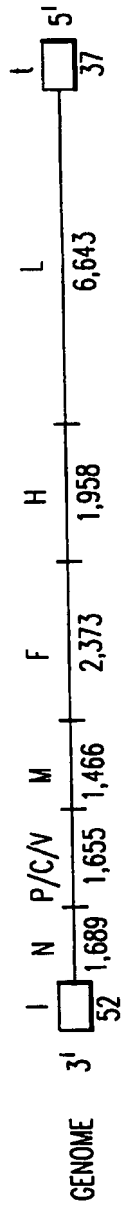


FIG.1

2/6



PUTATIVE EXTENDED PROMOTER AND REGULATORY REGIONS OF GENOME AND ANTIGENOME:  
HIGHLY CONSERVED CIS-ACTING DOMAINS

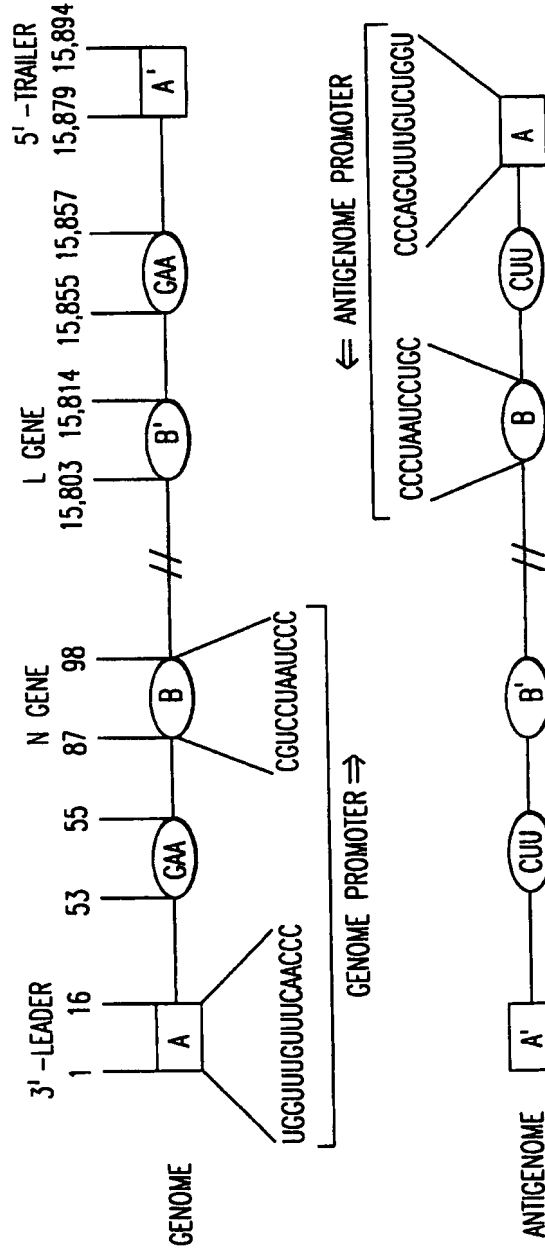
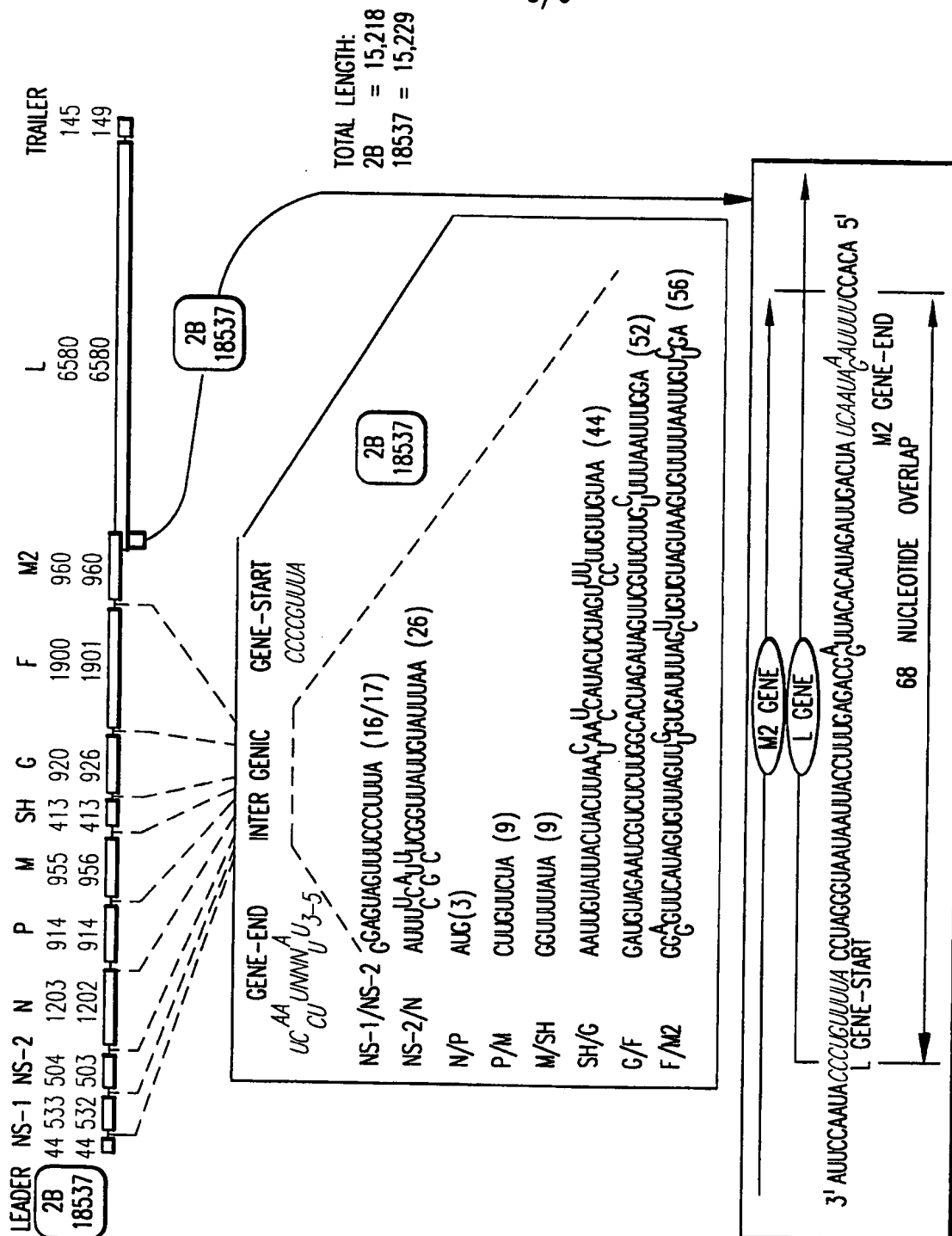


FIG.2

**FIG. 3**

**SUBSTITUTE SHEET (RULE 26)**



4/6

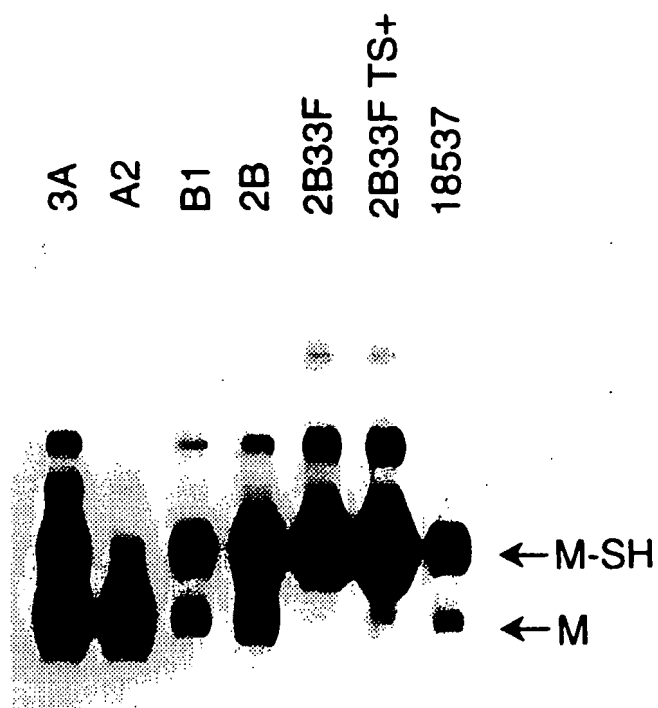


FIG.4



5/6

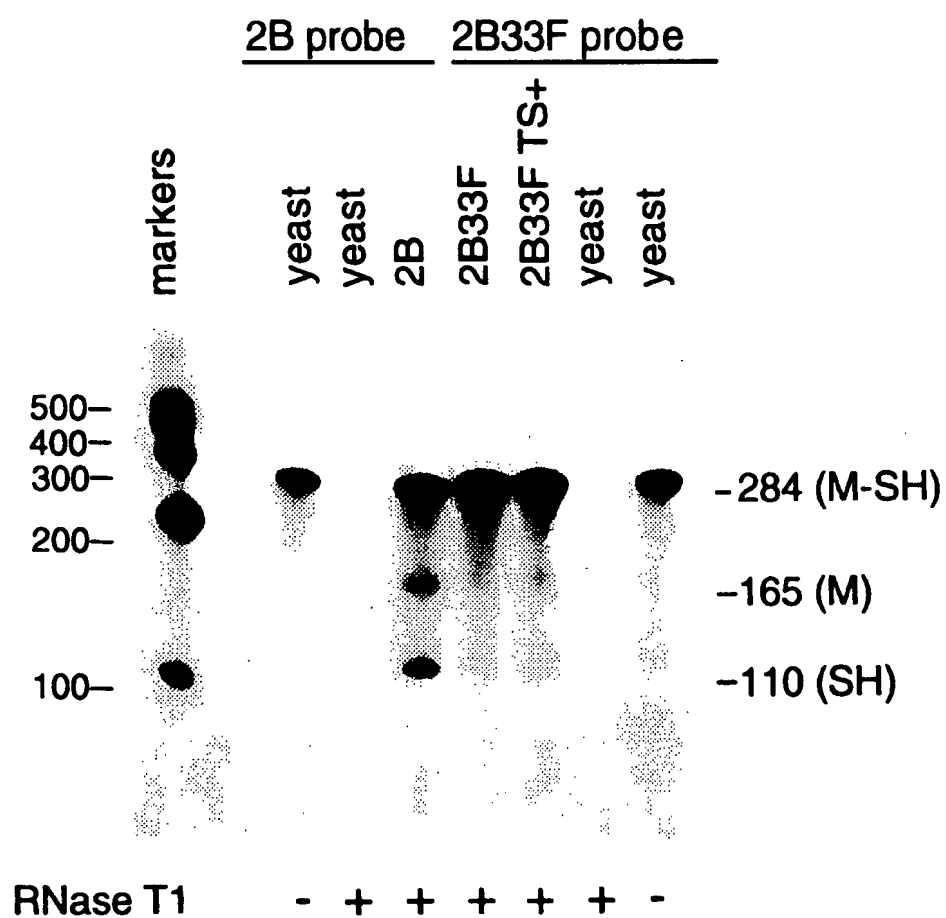


FIG. 5

6/6

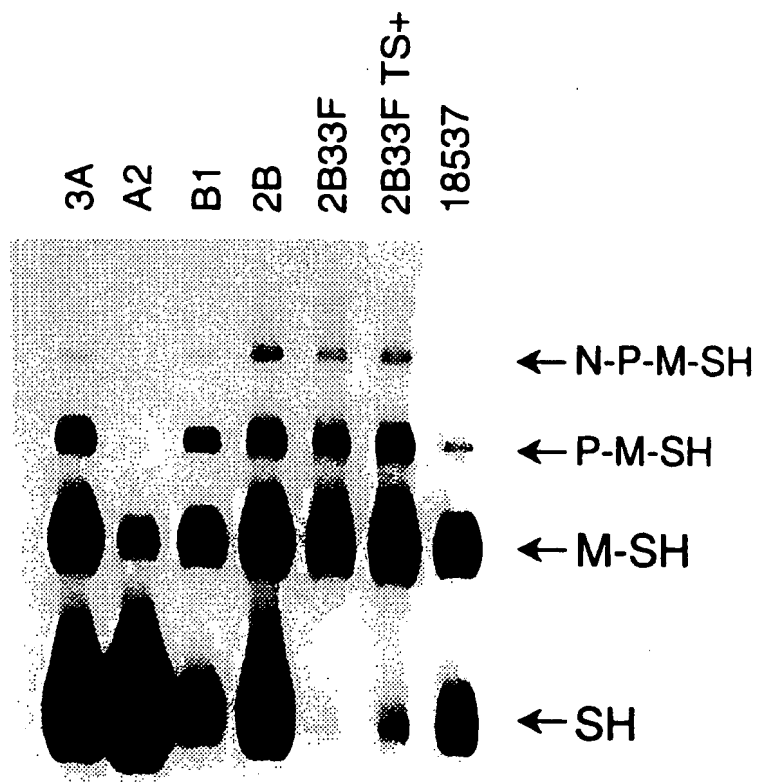


FIG.6

## SEQUENCE LISTING

<110> American Cyanamid Company

<120> Mutations Responsible for Attenuation in Measles Virus  
or Human Respiratory Syncytial Virus Subgroup B

<130> 33428-00/PCT

<140>

<141>

<150> 60/079466

<151> 1998-03-26

<160> 59

<170> PatentIn Ver. 2.0

<210> 1

<211> 15894

<212> DNA

<213> Measles virus

<400> 1

```

accaaacaaa gttgggtaag gatagatcaa tcaatgatca tattctagtg cacttaggat 60
tcaagatcct attatcaggg acaagagcag gattagggat atccgagatg gccacacttt 120
taaggagcct agcattgttc aaaagaaaaca aggacaaacc acccattaca tcaggatccg 180
gtggagccat cagaggaatc aaacacatta ttatagtacc aatccctgga gattcctcaa 240
ttaccactcg atccagactt ctggaccggt tggtcagggt aattggaaac ccgatgtga 300
gcgggcccac actaacaggg gcactaatag gtatattatc cttatttgtg gagtctccag 360
gtcaattgat tcagaggatc accgatgacc ctgacgttag cataaggctg ttagagggtg 420
tccagagtga ccagtcacaa tctggcctta ccttcgcatc aagaggtacc aacatggagg 480
atgaggcgga ccaatacttt tcacatgatg atccaattag tagtgatcaa tccaggttcg 540
gatggttcga gaacaaggaa atctcagata ttgaagtga agaccctgag ggattcaaca 600
tgattctggg taccatccta gcccaaattt gggctctgct cgcaaaggcg gttacggccc 660
cagacacggc agctgattcg gagctaagaa ggtggataaa gtacacccaa caaagaaggg 720
tagttggtga atttagattg gagagaaaat ggttgatgt ggtgaggaa aggattgccg 780
aggacctctc cttacgccga ttcattggtc ctctaactct ggatatcaag agaacacccg 840
gaaacaaacc caggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900
gattagccag ttttatcctg actattaagt ttgggataga aactatgtat cctgctcttg 960
gactgcatga atttgctggt gagttatcca cacttgagtc cttgatgaac ctttaccagc 1020
aaatggggga aactgcaccc tacatggtta tcctggagaa ctcaattcag aacaagttca 1080
gtgcaggatc atacctctg ctctggagct atgccatggg agtaggagtg gaacttgaaa 1140
actccatggg aggtttgaac tttggccgat cttactttga tccagcatat tttagattag 1200
ggcaagagat ggtaaggagg tcagctggaa aggtcagttc cacattggca totgaactcg 1260
gtatcactgc cgaggatgca aggcttggtt cagagattgc aatgcatact actgaggaca 1320
agatcagtag agcggttgga ccagacaaag cccaagtatc atttctacac ggtgatcaaa 1380

```

```

gtgagaatga gctaccgaga ttggggggca aggaagatag gaggggtcaaa cagagtcgag 1440
gagaagccag ggagagctac agagaaaccg ggcccagcag agcaagtgat gcgagagctg 1500
cccatcttcc aaccggcaca cccctagaca ttgacactgc atcgaggtcc agccaagatc 1560
cgcaggacag tcgaagggtca gctgacgccc tgcttaggct gcaagccatg gcaggaatct 1620
cggaagaaca aggctcagac acggacaccc ctatagtgtg caatgacaga aatcttctag 1680
actaggtgcg agaggccgag gaccagaaca acatccgcct accctccatc attgttataa 1740
aaaacttagg aaccaggtcc acacagccgc cagcccatca accatccact cccacgattg 1800
gagccgatgg cagaagagca ggcacgccat gtcaaaaacg gactggaatg catccgggct 1860
ctcaaggccg agcccatcgg ctactggcc atcgaggaag ctatggcagc atggtcagaa 1920
atatcagaca acccaggaca ggagcgagcc acctgcaggg aagagaaggc aggcagttcg 1980
ggtctcagca aaccatgcct ctacgaatt ggatcaactg aaggcgggtg acctcgcatc 2040
cgcgccaggg gacctggaga gagcgatgac gacgctgaaa ctttgggaat cccccaaga 2100
aatctccagg catcaagcac tgggttacag tgttattatg tttatgatca cagcggtgaa 2160
gcggttaagg gaatccaaga tgctgactct atcatgggtc aatcaggcct tgatggtgat 2220
agcaccctct caggaggaga caatgaatct gaaaacagcg atgtggatat tggcgaacct 2280
gataccgagg gatatgctat cactgaccgg ggatctgctc ccatctctat ggggttcagg 2340
gcttctgatg ttgaaactgc agaaggaggg gagatccacg agctcctgag actccaatcc 2400
agaggcaaca actttccgaa gcttgggaaa actctcaatg ttctccgcc cccggacccc 2460
ggtagggcca gcacttccga gacacccatt aaaaagggca cagacgcgag attagcctca 2520
tttggaacgg agatcgctc tttattgaca ggtggtgcaa cccaatgtgc tcgaaagtca 2580
ccctcggaac catcaggggc aggtgcacct gcggggaatg tccccgagtg tgtgagcaat 2640
gccgactga tacaggagtg gacacccgaa tctggtacca caatctcccc gagatcccag 2700
aataatgaag aagggggaga ctattatgat gatgagctgt tctctgatgt ccaagatatt 2760
aaaacagcct tggccaaaat acacagggat aatcagaaga taatctccaa gctagaatca 2820
ctgctgttat tgaagggaga agttgagtca attaagaagc agatcaacag gcaaaatatc 2880
agcatatcca ccctggaagg acacctctca agcatcatga tcgccattcc tggacttggg 2940
aaggatccca acgaccccac tgcagatgtc gaaatcaatc ccgacttgaa acccatcata 3000
ggcagagatt caggccgagc actggccgaa gttctcaaga aaccggttgc cagccgacaa 3060
ctccaaggaa tgacaaatgg acggaccagt tccagaggac agctgctgaa ggaatttcag 3120
ctaaagccga tcgggaaaaa gatgagctca gccgtcgggt ttgttctga caccggccct 3180
gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240
cgttacctga tgactctcct tgatgatatc aaaggagcca atgatcttgc caagttccac 3300
cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caaccccatg 3360
ccagtcgacc caactagtac aacctaaatc cattataaaa aacttaggag caaagtgatt 3420
gcctcccaag ttccacaatg acagagatct acgacttcca caagtcggca tgggacatca 3480
aagggtcgat cgctccgata caaccaccca cctacagtga tggcaggctg gtgccccagg 3540
tcagagtcag agatcctggg ctaggcgaca ggaaggatga atgctttatg tacatgtttc 3600
tgctgggggt tggtgagggc agcgatcccc tagggcctcc aatcgggcga gcatttgggt 3660
ccctgccctt aggtgttggc agatccacag caaagcccga agaactcctc aaagaggcca 3720
ctgagcttga catagtgtt agacgtacag cagggtcaa tgaaaaactg gtgttctaca 3780
acaacacccc actaactctc ctcacacctt ggagaaaggt cctaacaaca gggagtgtct 3840
tcaacgcaaa ccaagtgtgc aatgcggtta atctgatacc gctcgatacc ccgcagaggt 3900
tccgtgttgt ttatatgagc atcacccgtc tttcggataa cgggtattac accgttccca 3960
gaagaatgct ggaattcaga tcggtcaatg cagtggcctt caacctgctg gtgacctta 4020
ggattgacaa ggcgataggc cctgggaaga tcatcgacaa tacagagcaa cttcctgagg 4080
caacatttat ggtccacatc gggaaacttca ggagaaagaa gagtgaagtc tactctgccg 4140
attattgcaa aatgaaaatc gaaaagatgg gcctggtttt tgcacttggg gggatagggg 4200
gcaccagtct tcacattaga agcacaggca agatgagcaa gactctccat gcacaactcg 4260

```

```

ggttcaagaa gaccttatgt taccogctga tggatatcaa tgaagacctt aatcgattac 4320
tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagttcttc 4380
aagaattccg catttacgac gacgtgatca taaatgatga ccaaggacta ttcaaagttc 4440
tgtagaccgt agtgcaccagc aatgcccga aacgaccccc ctcaaatga cagccagaag 4500
gcccggacaa aaaagccccc tccgaaagac tccacggacc aagcgagagg ccagccagca 4560
gccgacggca agcgcgaaca ccaggcggcc ccagcacaga acagccctga cacaaggcca 4620
ccaccagcca ccccaatctg catcctcttc gtgggacccc cgaggaccaa ccccaaggc 4680
tgccccgat ccaaaccacc aaccgcatcc ccaccacccc cgggaaagaa acccccagca 4740
attggaaggc ccctccccct ctctctcaac acaagaactc cacaaccgaa ccgcacaagc 4800
gaccgagggtg acccaaccgc aggcattccga ctccctagac agatcctctc tccccggcaa 4860
actaaacaaa acttagggcc aaggaaacata cacacccaac agaaccaga ccccggccca 4920
cggcgcgcgcg cccccaaccc ccgacaacca gagggagccc ccaaccaatc ccgccggttc 4980
ccccggtgcc cacaggcagg gacaccaacc ccgaacaga ccagcacccc aaccatcgac 5040
aatccaagac gggggggccc ccccaaaaaa aggccccccag gggccgacag ccagcacccg 5100
gaggaagccc acccacccca cacacgacca cggcaaccaa accagaaccc agaccaccct 5160
gggccaccag ctcccagact cggccatcac cccgcagaaa ggaaaggcca caaccgcgc 5220
accccagccc cgatccggcg gggagccacc caaccggaac cagcacccaa gagcgatccc 5280
cgaaggaccc ccgaaccgca aaggacatca gtatcccaca gcctctccaa gtcccccggt 5340
ctcctccttt tctcgaaggg accaaaagat caatccacca caccgacga cactcaactc 5400
cccaccctta aaggagacac cgggaatccc agaatacaga ctcatccaat gtccatcatg 5460
ggtctcaagg tgaacgtctc tgccatattc atggcagtac tgtaactct ccagacacc 5520
accggtcaaa tccattgggg caatctctct aagatagggg tggtaggaat aggaagtgc 5580
agctacaaag ttatgactcg ttccagccat caatcattag tcataaaatt aatgcccaat 5640
ataactctcc tcaataactg cacgagggtg gagattgcag aatacaggag actactgaga 5700
acagttttgg aaccaattag agatgcactt aatgcaatga ccagaatat aagaccggtt 5760
cagagtgtag cttcaagtag gagacacaag agatttgogg gagtagtct ggagggtgcg 5820
gccttaggcg ttgccacagc tgctcagata acagccggca ttgcacttca ccagtccatg 5880
ctgaactctc aagccatcga caatctgaga gcgagcctgg aaactactaa tcaggcaatt 5940
gaggcaatca gacaagcagg gcaggagatg atattggctg ttcagggtgt ccaagactac 6000
atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaat cggccagaag 6060
ctcgggctca aattgctcag atactataca gaaatcctgt cattatttgg cccagctta 6120
cgggacccca tatctgcgga gatattctatc caggctttga gctatgcgct tggaggagac 6180
atcaataagg tgtagaaaa gctcgggatac agtggagggtg atttactggg catcttagag 6240
agcagaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtcttc 6300
agtatagcct atccgacgct gtccgagatt aaggggggtg ttgtccaccg gctagagggg 6360
gtctcgtaca acataggctc tcaagagtgg tataccactg tgccaagta tttgcaacc 6420
caagggtacc ttatctcgaa ttttgatgag tcatcgtgta ctttcatgcc agaggggact 6480
gtgtgcagcc aaaatgcctt gtacccgatg agtcctctgc tccaagaatg cctccggggg 6540
tccaccaagt cctgtgctcg tacactcgta tccgggtctt ttgggaaccg gttcatttta 6600
tcacaaggga acctaatagc caattgtgca tcaatccttt gcaagtgtta cacaacagga 6660
acgatcatta atcaagaccc tgacaagatc ctaacataca ttgctgccga tctactgccg 6720
gtagtgcagg tgaacggcgt gaccatccaa gtcgggagca ggaggtatcc agacgctgtg 6780
tacttgcaca gaattgacct cggtcctccc atatcattgg agaggttgga cgtagggaca 6840
aatctgggga atgcaattgc taagttggag gatgccaagg aattgttgga gtcacggac 6900
cagatattga ggagtatgaa aggtttatcg agcactagca tagtctacat cctgattgca 6960
gtgtgtcttg gagggttgat agggatcccc gctttaatg gttgctgcag ggggcgttgt 7020
aacaaaaagg gagaacaagt tggatatgtc agaccaggcc taaagcctga tcttacggga 7080
acatcaaaat cctatgtaag gtcgctctga tcctctacaa ctcttgaaac acaaatgtcc 7140

```

cacaagtctc ctcttcgtca tcaagcaacc accgcaccca gcatcaagcc cacctgaaat 7200  
tatctccggc ttccctctgg ccgaacaata tcggtagtta attaaaactt aggggtgcaag 7260  
atcatccaca atgtcaccac aacgagaccg gataaatgcc ttctacaaag ataaccceca 7320  
tcccaaggga agtaggatag tcattaacag agaacatctt atgattgata gaccttatgt 7380  
tttgctggct gttctgtttg tcatgtctct gagcttgatc gggttgctag ccattgcagg 7440  
cattagactt catcgggcag ccatctacac cgcagagatc cataaaagcc tcagcaccaa 7500  
tctagatgta actaactcaa tcgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560  
aatcatcggg gatgaagtgg gcctgaggac acctcagaga ttactgacc tagtgaaatt 7620  
catctctgac aagattaaat tccttaatcc ggatagggag tacgacttca gagatctcac 7680  
ttggtgtatc aaccgcccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740  
ggctgctgaa gagctcatga atgcattggg gaactcaact ctactggaga ccagaacaac 7800  
caatcagttc ctagtctgtc caaagggaac ctgctcaggg ccactacaa tcagaggtca 7860  
attctcaaac atgtcgtgtt ccctgttaga cttgtattta agtcgaggtt acaatgtgtc 7920  
atctatagtc actatgacat cccagggaat gtatggggga acttacctag tggaaaagcc 7980  
taatctgagc agcaaaaggt cagagttgtc acaactgagc atgtaccgag tgtttgaagt 8040  
aggtgttatc agaaatccgg gtttgggggc tccggtgttc catatgacaa actatcttga 8100  
gcaaccagtc agtaatgac tcagcaactg tatggtggct ttgggggagc tcaaactcgc 8160  
agccctttgt cacggggaag attctatcac aattccctat cagggatcag ggaaaggtgt 8220  
cagcttccag ctctgcaagc taggtgtctg gaaatcccca accgacatgc aatcctgggt 8280  
ccccttatca acggatgac cagtgataga caggctttac ctctcatctc acagaggtgt 8340  
tatcgtgac aatcaagcaa aatgggctgt cccgacaaca cgaacagatg acaagtgtcg 8400  
aatggagaca tgcttccaac aggcgtgtaa gggtaaaatc caagcactct gcgagaatcc 8460  
cgagtgggca ccattgaagg ataacaggat tccttcatac ggggtcttgt ctgttgatct 8520  
gagtctgaca gttgagctta aaatcaaaat tgcttcggga ttccggccat tgatcacaca 8580  
cggttcaggg atggacctat acaaatccaa ccacaacaat gtgtattggc tgactatccc 8640  
gccaatgaag aacctagcct taggtgtaat caacacattg gagtggatac cgagattcaa 8700  
ggttagtccc aacctcttca ctgtcccaat taagggaagc ggcgaagact gccatgcccc 8760  
aacataccta cctgcggagg tggatgggta tgtcaaaact agttccaatc tgggtgattct 8820  
acctggtcaa gatctccaat atgttttggc aacctacgat acttccaggg ttgaacatgc 8880  
tgtggtttat tacgtttaca gccaggccg ctcatcttct tacttttate cttttagggt 8940  
gcctataaag ggggtcccca tcgaattaca agtggaatgc ttcacatggg accaaaaact 9000  
ctggtgccgt cacttctgtg tgcttgcgga ctacagaatct ggtggacata tcaactcactc 9060  
tgggatgggt ggcatgggag tcagctgcac agtcaccccg gaagatggaa ccaatcgag 9120  
atagggtctg tagtgaacca atcacatgat gtcaccaga catcaggcat acccactagt 9180  
gtgaaataga catcagaatt aagaaaaacg tagggtccaa gtggttcccc gttatggact 9240  
cgctatctgt caaccagatc ttataccctg aagttcacct agatagcccg atagttacca 9300  
ataagatagt agccatcctg gagtatgtc gagtccctca cgcttacagc ctggaggacc 9360  
ctacactgtg tcagaacatc aagcaccgcc taaaaaacgg attttccaac caaatgatta 9420  
taaacaatgt ggaagtggg aatgtcatca agtccaagct taggagttat ccggccact 9480  
ctcatattcc atatccaaat tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540  
cgaggaagat ccgtgaactc ctcaaaaagg ggaattcgct gtactccaaa gtcagtata 9600  
aggttttcca atgcttaagg gacactaact cacggcttgg cctaggctcc gaattgaggg 9660  
aggacatcaa ggagaaagtt attacttggt gagtttacat gcacagctcc cagtggtttg 9720  
agccctttct gttttgggtt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780  
ccataacttg ccataggagg agacacacac ctgtattctt cactggtagt tcagttgagt 9840  
tgctaactct tcgtgacctt gttgctataa tcagtaaaga gtctcaacat gtatattacc 9900  
tgacatttga actgggtttg atgtattgtg atgtcataga ggggaggtta atgacagaga 9960  
ccgctatgac tattgatgct aggtatacag agcttctagg aagagtcaga tacatgtgga 10020

aactgataga tgggtttcttc cctgcactcg ggaatccaac ttatcaaatt gtagccatgc 10080  
tggagcctct ttcacttgct tacctgcagc tgagggatat aacagtagaa ctgagagggtg 10140  
ctttccttaa ccactgcttt actgaaatac atgatgttct tgacaaaaac ggggttttctg 10200  
atgaaggtag ttatcatgag ttaattgaag ctctagatta ctttttcata actgatgaca 10260  
tacatctgac aggggagatt ttctcatttt tcagaagttt cggccacccc agacttgaag 10320  
cagtaacggc tgctgaaaat gttaggaaat acatgaatca gcctaaagtc attgtgtatg 10380  
agactctgat gaaaggatcat gccatatttt gtggaatcat aatcaacggc tatcgtgaca 10440  
ggcacggagg cagttggcca ccgctgaccc tccccctgca tgctgcagac acaatccgga 10500  
atgctcaagc ttcagggtgaa ggggttaacac atgagcagtg cgttgataac tggaaatctt 10560  
ttgctggagt gaaatttggc tgctttatgc ctcttagcct ggatagtgat ctgacaatgt 10620  
acctaaagga caaggcactt gctgctctcc aaagggaaatg ggattcagtt taccgaaaag 10680  
agttcctgag ttacgaccct cccaaggga cggggtcacg gaggcttgta gatgttttcc 10740  
ttaatgattc gagctttgac ccatatgatg tgataatgta tgttgtaagt ggagcttacc 10800  
tccatgaccc tgagttcaac ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860  
gtagactttt tgctaaaatg acttacaata tgagggcatg ccaagtgatt gctgaaaatc 10920  
taatctcaaa cgggattggc aaatatttta aggacaatgg gatggccaag gatgagcacg 10980  
atgtgactaa ggcactccac actctagctg tctcaggagt ccccaaagat ctcaaagaaa 11040  
gtcacagggg ggggcccagtc ttaaaaacct actcccgaag cccagtcac acaagtacca 11100  
ggaacgtgag agcagcaaaa ggggtttatag ggttccctca agtaattcgg caggaccaag 11160  
acactgatca tccggagaat atggaagctt acgagacagt cagtgcattt atcacgactg 11220  
atctcaagaa gtactgcctt aattggagat atgagaccat cagcttggtt gcacagaggc 11280  
taaattgagat ttacggattg cctcattttt tccagtggct gcataagagg cttgagacct 11340  
ctgtcctgta tgtaagtgac cctcattgcc cccccgacct tgacgccccat atcccgttat 11400  
ataaagtccc caatgatcaa atcttcatta agtaccctat gggagggtata gaagggtatt 11460  
gtcagaagct gtggaccatc agcaccattc cctatctata cctggctgct tatgagagcg 11520  
gagtaaggat tgcttcgtta gtgcaagggg acaatcagac catagccgta acaaaaaggg 11580  
taccagcac atggccctac aaccttaaga aacgggaagc tgctagagta actagagatt 11640  
actttgtaat tcttaggcaa aggetacatg atattggcca tcacctcaag gcaaatgaga 11700  
caattgtttc atcacatttt tttgtctatt caaaaggaa atattatgat gggctacttg 11760  
tgtcccaatc actcaagagc atcgcaagat gtgtattctg gtcagagact atagttgatg 11820  
aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagagggt 11880  
atgaccgtta ccttgcatat tccctgaacg tcctaaaagt gatacagcaa attctgatct 11940  
ctcttggtt cacaatcaat tcaaccatga cccgggatgt agtcataccc ctctcaca 12000  
acaacgacct cttaataagg atggcactgt tgcccgctcc tattgggggg atgaattatc 12060  
tgaatatgag caggctgttt gtcagaaaca tgggtgatcc agtaacatca tcaattgctg 12120  
atctcaagag aatgattctc gcctcactaa tgctgaaga gacctccat caagtaatga 12180  
cacaacaacc gggggactct tcattcctag actgggctag cgaccttac tcagcaaatc 12240  
ttgtatgtgt ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctga 12300  
tccatagtcc aaacccaatg ttaaaaggat tattccatga tgacagtaaa gaaggaggcg 12360  
agggactggc ggcattcctc atggacaggc atattatagt acctagggca gctcatgaaa 12420  
tcctggatca tagtgtcaca ggggcaagag agtctattgc aggcagctg gataccacaa 12480  
aaggcctgat tccagccagc atgaggaagg ggggggttaac ctctcgagtg ataaccagat 12540  
tgtccaatta tgactatgaa caattcagag cagggatggt gctattgaca ggaagaaaga 12600  
gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggcgagagct ctaagaagcc 12660  
atatgtgggc gaggctagct cgaggacggc ctatttacgg ccttgaggtc cctgatgtac 12720  
tagaatctat gcgaggccac cttattcggc gtcattgagac atgtgtcatc tgcgagtgtg 12780  
gatcagtc aa ctacggatgg ttttttgtcc cctcgggttg ccaactggat gatattgaca 12840  
aggaaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900

tgaagcttgc cttcgtaaga gcccgaagtc gatccttgcg atctgctggt agaataagcaa 12960  
 cagtgtactc atgggcttac ggtgatgatg atagctcttg gaacgaagcc tggttggttg 13020  
 ctaggcaaaag ggccaatgtg agcctggagg agctaagggt gatcactccc atctcaactt 13080  
 cgactaattt agcgcatagg ttgagggatc gtagcactca agtgaaatac tcagggtacat 13140  
 cccttgctcg agtggcgagg tataccacaa tctccaacga caatctctca ttgtcatat 13200  
 cagataagaa ggttgatact aactttatat accaacaagg aatgcttcta gggttgggtg 13260  
 ttttagaaac attgtttcga ctcgagaaag ataccggatc atctaacacg gtattacatc 13320  
 ttcacgtcga aacagattgt tgcgtgatcc cgatgataga tcatcccagg ataccagct 13380  
 cccgcaagct agagctgagg gcagagctat gtaccaaccc attgatatat gataatgcac 13440  
 ctttaattga cagagatgca acaaggctat acaccagag ccataggagg caccttggtg 13500  
 aatttggttac atggtccaca cccaactat atcacatctt agctaagtcc acagcactat 13560  
 ctatgattga cctggtaaca aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620  
 taggggatga cgatatcaat agtttcataa ctgagtttct gctcatagag ccaagattat 13680  
 tcactatcta cttgggccag tgtgcggcca tcaattgggc attgatgta cattatcata 13740  
 gaccatcagg gaaatatcag atgggtgagc tgtgtcatc gttcctttct agaatagagca 13800  
 aaggagtgtt taagggtgct gtcaatgctc taagccaccc aaagatctac aagaattct 13860  
 ggcattgttg tattatagag cctatccatg gtccttctact tgatgctcaa aacttgaca 13920  
 caactgtgtg caacatggtt tacacatgct atatgacctt cctcgacctg ttgttgaatg 13980  
 aagagttaga agagtccaca tttctcttgt gtgaaagcga cgaggatgta gtaccggaca 14040  
 gattcgacaa catccaggca aaacacttat gtgttctggc agatttgta tgtcaaccag 14100  
 ggacctgccc accaattcga ggtctaagac cggtagagaa atgtgcagtt ctaaccgacc 14160  
 atatcaaggc agaggctagg ttatctccag caggatcttc gtggaacata aatccaatta 14220  
 ttgtagacca ttactcatgc tctctgactt atctccggcg aggatcgatc aaacagataa 14280  
 gattgagagt tgatccagga ttcatcttcg acgcccctgc tgaggtaaat gtcagtcagc 14340  
 caaagatcgg cagcaacaac atctcaaata tgagcatcaa ggatttcaga cccccacag 14400  
 atgatgttgc aaaattgctc aaagatatca acacaagcaa gcacaatctt cccatttcag 14460  
 ggggcaatct cgccaattat gaaatccatg ctttcgcgag aatcgggttg aactcatctg 14520  
 cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccaggggag 14580  
 acggcttggt cttgggtgag ggatcgggtt ctatgttgat cacttataag gagatactta 14640  
 aactaaacaa gtgcttctat aatagtgggg tttccgcaa ttctagatct ggtcaaagg 14700  
 aattagcacc ctatccctcc gaagtgggcc ttgtcgaa caagaatggga gtaggtaata 14760  
 ttgtcaaagt gctctttaac gggaggcccg aagtcacgtg ggtaggcagt gtagattgct 14820  
 tcaatttcac agttagtaat atccctacct ctagtgtggg gtttatccat tcagatatag 14880  
 agaccttgcc taacaaagat actatagaga agctagagga attggcagcc atcttatcga 14940  
 tggtcttgct cctgggcaaa ataggatcaa tactggtgat taagcttatg cctttcagcg 15000  
 gggattttgt tcagggattt ataagttatg tagggtctca ttatagagaa gtgaaccttg 15060  
 tataccctag atacagcaac ttcatatcta ctgaatctta tttggttatg acagatctca 15120  
 aggctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcatctgtga 15180  
 ggacttcacc tggacttata ggtcacatcc tatccattaa gcaactaagc tgcatacaag 15240  
 caattgtggg agacgcagtt agtagaggtg atatcaatcc tactctgaaa aaacttacac 15300  
 ctatagagca ggtgctgatc aattgcgggt tggcaattaa cggacctag ctgtgcaaag 15360  
 aattgatcca ccatgatgtt gcctcagggc aagatggatt gcttaattct atactcatcc 15420  
 tctacaggga gttggcaaga ttcaaagaca accaaagaag tcaacaagg atgttccacg 15480  
 cttaccccgct attggtaagt agcaggcaac gagaacttat atctaggatc acccgcaaat 15540  
 tttgggggca cattcttctt tactccggga acagaaagtt gataaataag tttatccaga 15600  
 atctcaagtc cggttatctg atactagact tacaccagaa tatctctggt aagaatctat 15660  
 ccaagtcaga gaaacagatt attatgacgg ggggtttgaa acgtgagtg gtttttaagg 15720  
 taacagtcaa ggagaccaa gaatggtata agttagtcgg atacagtgcc ctgattaagg 15780



actaattggt tgaactccgg aaccctaatac ctgccctagg tggtaggca ttatttgcaa 15840  
 tatattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

<210> 2

<211> 15894

<212> DNA

<213> Measles virus

<400> 2

accaaacaaa gttgggtaag gatagatcaa tcaatgatca tattctagta cacttaggat 60  
 tcaagatcct attatcaggg acaagagcag gattagggat atccgagatg gccacacttc 120  
 taaggagcct agcattgttc aaaagaaaca aggacaaacc acccattaca tcaggatccg 180  
 gtggagccat cagaggaatc aaacacatta ttatagtacc aatcccgga gattcctcaa 240  
 ttaccactcg atctagactt ctggaccggt tggtcagggt aattggaaac ccgatgtga 300  
 gcgggcccac actaacaggg gcactaatag gtatattatc cttatttgtg gagtctccag 360  
 gtcaattgat tcagaggatc accgatgacc ctgacgttag cataaggctg ttagagggtg 420  
 tccagagtga ccagtcacaa tctggcctta ccttcgcac aagaggtagc aacatggagg 480  
 atgaggcgga ccaatatttt tcacatgatg atccaagtag tagtgatcaa tccagggttcg 540  
 gatggttcga gaacaaggaa atctcagata ttgaagtga agaccctgag ggattcaaca 600  
 tgattctggg taccatccta gctcaaattt gggctctgct cgcaaaggcg gttacggccc 660  
 cagacacggc agctgattcg gagctaagaa ggtggataaa gtacacccaa caaagaaggg 720  
 tagttggtga atttagattg gagagaaaat ggttgatgt ggtgaggaac aggattgccg 780  
 aggacctctc cttacgccga ttcattggtc ctctaatect ggatatcaag agaacacccg 840  
 ggaacaaacc caggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900  
 gattagccag ttttatcctg actattaagt ttgggataga aactatgtat cctgctcttg 960  
 gactgcatga atttgcctgt gagttatcca cacttgagtc cttgatgaat ctttaccagc 1020  
 aatggggga aactgcacca tacatggtaa tcctggagaa ctcaattcag aacaagttca 1080  
 gtgcaggatc ataccctctg ctctggagct atgccatggg agtaggagtg gaacttgaaa 1140  
 actccatggg aggtttgaac tttggccgat cttacttcga tccagcatat ttcagactag 1200  
 ggcaagagat ggtgaggagg tcagctggaa aggtcagttc cacattggca tctgaactcg 1260  
 gtatcactgc cgaagatgca aggcttgttt cagagatcgc aatgcatact acagaggaca 1320  
 ggatcagtag agcggttgga cccagacaat cccaagtgtc attcctacac ggtgatcaa 1380  
 atgaaaatga gctaccgaga tgggggggta aggaagatat gaggggtcaa cagagtcggg 1440  
 gagaagccag agagagctac agagaaacca ggcccagcag agcaagtga gcgagagcta 1500  
 cccatcctcc aaccgacaca cccttagaca ttgacactgc atcggagtcc agccaagatc 1560  
 cgcaggacag tcgaaggcca gctgacgccc tgctcaggct gcaagccatg gcaggaatct 1620  
 cgaagaaca aggtcagac acggacaccc cttagagtga caatgacaga gatcttctag 1680  
 actagggtga agaggccgag gaccagaaca acatccgcct accctccatc attgttataa 1740  
 aaaacttagg aaccaggtcc acacagccgc cagcccacca accatccact cccacgattg 1800  
 gggccgatgg cagaagagca ggcacgccat gtcaaaaacg gactggaatg catccgggct 1860  
 ctcaaggccg agcccatcgg ctactggcc atcgaggaag ctatggcagc atggtcagaa 1920  
 atatcagaca acccaggaca ggagcgagcc gcctgcaagg aagagaaggc aagcagtcg 1980  
 ggtctcagca aacctgcct ctcagcaatt ggatcaactg aaggcgggtc acctcgcatc 2040  
 cgcggtcagg gatctggaga gagcgatgac gacgctgaaa ctttgggaat cccctcagga 2100  
 aatctccagg catcaagcac tgggttacag tgttattatg tttatgatca cagcggtgaa 2160  
 gcgggttaagg gaatccaaga tgctgactct atcatgggtc aatcaggcct tgatgggtgat 2220  
 agcaccctct caggaggaga caatgaatct gaaaacagcg atgtggatat tggcgaaacct 2280  
 gataccgagg gatatgctat cactgaccgg ggatctgctc ccatctctat ggggttcagg 2340

gcttctgatg ttgaaactgc agaaggaggg gagatccacg agctcctgag actccaatcc 2400  
agaggcaaca actttccaaa gcttaggaaa actctcaatg ttccccgcc cccggaccct 2460  
ggtagggcca gcacttccga gacaccatt aaaaaggga cagacgcgag attagcctca 2520  
tttggaaagg agatcgctc tttattgaca ggtggtgcaa cccaatgtgc tcgaaagtca 2580  
ccctcggaac catcagggcc aggtgcacct gcggggaatg tccccgagtg tgtgagcaat 2640  
gccgtactga tacaggagtg gacaccgaa tctggtacca caatctcccc gagatcccag 2700  
aataatgaag aagggggaga ttattatgat gatgagctgt tctctgatgt ccaagatatt 2760  
aaaacagcct tggccaaaat acacgaggat aatcagaaga taatcaccaa gctagaatca 2820  
ctgctgttat tgaaggggga agttgagtca atcaagaagc agatcaacag gcaaaatc 2880  
agcatatcca ccttgggaagg acacctctca agcatcatga tcgccattcc tggacttggg 2940  
aaggatccca acgacccccc tgcagatgtc gaaatcaatc ccgacttgaa acccatcata 3000  
ggcagagatt caggccgagc actggctgaa gttctcaaga aaccggtgc cagccgacaa 3060  
atccaaggaa tgacaaatgg acggaccagt tccagaggac agctgctgaa ggaatttcag 3120  
ctaaagccga tcgggaaaaa gatgagctca gccgtcgggt ttgttccgga caccggccct 3180  
gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240  
cgttacctga tgactctcct tgatgacatc aaaggagcca acgatcttgc caagtccac 3300  
cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caaccccatg 3360  
ccagtcgacc tagctaatac aacctaaatc cattataaaa aacttaggag caaagtgatt 3420  
gcctcccaag ttccacaatg acagagatct acgacttcca caagtccgca tgggacatca 3480  
aagggtcgat cgctccgata caaccaccca cctacagtga tggcaggctg gtgccccagg 3540  
tcagagtcac agatcctggg ctaggcgaca gaaaagatga atgttttatg tacatgtttc 3600  
tgctgggggt tgttgaggac agcgatctcc tagggcctcc aatcgggcca gcatttgggt 3660  
ctctgccctt aggtgttggc agatccacag caaaaccca agaactctc aaagaggcca 3720  
ctgagcttga catagttgtt agacgtacag cagggtcaa tgaaaaactg gtgttctaca 3780  
acaacacccc actaactctc ctcatacctt ggagaaaggt cctaacaaca gggagtgtct 3840  
tcaacgcaaa ccaagtgtgc aatgcgggta atctgatacc gctggatacc ccgagagggt 3900  
tccgtgttgt ttatatgagc atcacccgtc tttcagataa cgggtattac accgttccca 3960  
gaagaatgct ggaattcaga tcggtcaatg cagtggcctt caacctgctg gtgaccctta 4020  
ggattgacaa ggcgattggc catgggaaga tcatcgacaa tgcagagcaa ctctctgagg 4080  
caacatttat ggtccacatc gggaaacttca ggagaaagaa aagtgaagtc tactctgccg 4140  
attattgcaa aatgaaaatc gaaaagatgg gcctgggttt tgcacttggg gggatagggg 4200  
gcaccagtct tcacattaga agcacaggca aaatgagcaa gactctccat gcacaactcg 4260  
ggttcaagaa gaccctatgt taccactga tggatatcaa tgaagacctt aatcgattac 4320  
tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagtctctc 4380  
aagaattccg catttacgac gacgttatca taaatgatga ccaaggatta ttcaaagttc 4440  
tgtagaccgt agtgcccagc aatgcccga gacgacctc ctcaaatga cagccagaag 4500  
gcccggaaaa aaaggccccc tccgaaagac tccacagacc aaatgagagg ccagccagca 4560  
gctgacggca agcacgaaca ccaggcgccc ccagcacaga acagccctga cataaggcca 4620  
ccaccagcca tcccaatctg catctctctc gtaggacccc cgaggaccaa cccccaagg 4680  
tgccccccac ccaaaccacc aaccgcatcc ctaccacccc cgggaaagaa acccccagca 4740  
actggaagag cccttcccct ttcctcaac acaagaactc cacaaccgaa ccacacaagc 4800  
gaccgaggtg acccaaccgc aggcacccga ctccctagac agatcctctc cccctggcaa 4860  
actaaacaaa acttagggcc aaggaacata cacaccaac agaaccaga ccccgccca 4920  
cggcgccgag ccccaacccc ccgacaacca gagggagccc ccaaccaatc ccgcccgtc 4980  
ccccggtgcc cacaggcagg cacaccaacc cccgaacaga cccagcacc agccatcgac 5040  
aatccaagac gggggggccc ccccaaaaaa agggcccccag gggccgacag ccagcaccgc 5100  
gaggaagccc acccacccca cacacgacca cgacaaccaa accagaacc agaccacct 5160  
gggcccaccag ttcccagact cggccatcac cccgcagaaa ggaaaggcca caacctgcgc 5220

accccagccc cgatccggcg ggcagccacc caaccctaac cagcacccaa gagcgatccc 5280  
 cgaaggaccc ccgaaccgca aaggacatca gtatcccaca gcctctccaa gtcccccggt 5340  
 ctcttcctct tctcgaaggg actaaaagat caatccacca catccgacga cactcaactc 5400  
 cccgtcccta aaggagacac cgggaatccc ggaattaaga ctcatccaat gtccatcatg 5460  
 ggtctcaagg tgaacgtctc tgccatattc atggcagtac tgtaactct ccaaaccacc 5520  
 accggtcaaa tccattgggg caatctctct aagatagggg tggtaggaat aggaagtgc 5580  
 agctacaaag ttatgactcg ttccagccat caatcattag tcataaaatt aatgcccaat 5640  
 ataactctcc tcaataactg cacgagggtg gagattgcag aatacaggag actactgaga 5700  
 acagttttgg aaccaattag agatgcactt aatgcaatga ccagaatat aagaccgttt 5760  
 cagagtgtag cttcaagtag gagacacaag agatttgag gagtagtcct ggtaggtgcg 5820  
 gccctaggcg ttgccacagc tgctcagata acagccggca ttgcacttca ccagtccatg 5880  
 ctgaactctc aagccatcga caatctgagg gcaagtctgg aaactactaa tcaggcaatt 5940  
 gaggcaatca gacaagcagg gcaggagatg atattggctg ttcaggggtg ccaagactac 6000  
 atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaat cggccagaag 6060  
 ctcggtctca aattgctcag atactataca gaaatcctgt cattatttgg ccctagctta 6120  
 cgggaccca tatctgcgga gatatctatc caggctttga gctatgcgct cggaggagat 6180  
 atcaataagg tgtagaaaa gctcggatat agtgagggtg atttactggg catcttagag 6240  
 agcagaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtcctc 6300  
 agtatagcct acccgacgct gtccgagatc aaggggggtg ttgtccaccg gctagagggg 6360  
 gtctcgtaca acataggctc tcaagagtgg tatacgactg tgccaagta tgttgcaacc 6420  
 caagggtacc ttatctcgaa ttttgatgag tcatcggtgta ctttcatgcc agaggggact 6480  
 gtgtgcagcc aaaatgcctt gtacccgatg agtcctctgc tccaagaatg cctccggggg 6540  
 tccaccaagt cctgtgctcg tacactcgta tctgggtctt ttgggaaccg gttcattttg 6600  
 tcacaaggga acctaatagc caattgtgca tcaatccttt gcaagtgtta cacaacagga 6660  
 acgatcatta atcaagaccc tgacaagatc ctaacataca ttgctgccga tctactgccg 6720  
 gtagtcgagg tgaacggcgt gaccatccaa gtcgggagca ggaggtatcc agacgtctg 6780  
 tacttgaca gaattgacct cggctctccc atatcattgg agaggttga cgtagggaca 6840  
 aatctgggga atgcaattgc taagttggag gatgccaagg aattgttga gtcacggac 6900  
 cagatattga ggagtatgaa aggtttgtcg agcactagca tagtctacat cctgattgca 6960  
 gtgtgtcttg gagggttgat agggatcccc gctttaatg gttgctgcag gggcggtgt 7020  
 aacaaaaagg gagaacaagt tggatatgca agaccaggcc taaagcctga tcttacagga 7080  
 acatcgaaat cctatgtaag gtcgctctga tcctctacaa ctcttggaa acaaatgtcc 7140  
 cacaagtctc ctcttcgtca tcaagcaacc accgcatcca gcatcaagcc cacctgaaat 7200  
 tatctccggc tccccttgg ccgaacaata tcggtagtta attaaaactt agggtgcaag 7260  
 atcatccaca atgtcaccac aacgagaccg gataaatgcc ttctacaaag ataaccacca 7320  
 tcccaaggga agtaggatag ttatcaacag agaacacctt atgattgata gaccttatgt 7380  
 tttgctggct gttctgttcg tcatgtttct gagcttgatc gggttgctag caattgcagg 7440  
 cattagactt catcgggcag ccactctacac cgcagagatc cataaaagcc tcagcacc 7500  
 tctagatgta actaactcaa ttgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560  
 aatcatcggt gatgaagtgg gcctgaggac acctcagaga ttactgacc tagtgaaatt 7620  
 catctctgac aagattaaat tccttaacct ggatagggag tacgacttca gagatctcac 7680  
 ttggtgtatc aaccgccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740  
 ggctgctgaa gagctcatga atgcattggg gaactcaact ctactggaga ccagaacaac 7800  
 caatcagttc ctactgtct caaaggga ctgctcaggg cccactacaa tcagaggtca 7860  
 attctcaaac atgtcgtgt cctgttggga cttgtattta agtcgagggt acaatgtgtc 7920  
 atctatagtc actatgacat cccagggaat gtacggggga acttacctag tggaaaagcc 7980  
 taatctgagc agcaaagggt cagagttgtc acaactgagc atgtaccgag tgtttgaagt 8040  
 aggtgttatc agaaatccgg gtttgggggc tccggtgttc catatgacaa actattttga 8100

gcaaccagtc agtaatgata tcagcaactg tatggtggct ttgggggagc tcaaactcgc 8160  
 agccctttgt cacgggggag attctatcac aattccctat cagggatcag ggaaagggtg 8220  
 cagcttttcag ctctgtaagc taggtgtctg gaaatcccca accgacatgc aatcctgggt 8280  
 cccctttctca acggatgacc cagtgtataga caggctttac ctctcatctc acagagggtg 8340  
 tatcgctgac aatcaagcaa aatgggctat cccgacaaca agaacagatg acaagttgcg 8400  
 aatggagaca tgcttccagc aggcgtgtaa gggtaaaatc caagcactct gcgagaatcc 8460  
 cgagtgggca ccattgaagg ataacaggat tccttcatac ggagtcttgt ctgttgatct 8520  
 gagtctaaca gttgagctta aaatcaaaat tgcttcggga ttcggggccat tgatcacaca 8580  
 cggttcaggg atggacctat acaagtccaa ccacaacaat gagtattggc tgactatccc 8640  
 gccaatgaag aacctagccc taggtgtaat caacacattg gagtggatac cgagattcaa 8700  
 ggtagtccc aacctcttca ctgtcccaat taagggaagc ggcgaagact gccatgcccc 8760  
 aacataccta cctgcggagg tggatggtga tgtcaaaactc agttccaatc tggatgacct 8820  
 acctggtcaa gatctccaat atgttttggc aacctacgat acttccaggg ttgaacatgc 8880  
 tgtggtttat tacgtttaca gcccaagccg ctcatcttct tactttttatc cttttagggt 8940  
 gcctataaag gggatcccca tcgaattaca agtggaatgc ttcacatggg accaaaaact 9000  
 ctggtgccgt cacttctgtg tgcttgcgga ctcagaatct ggtggacata tcaactcctc 9060  
 tgggatgggt ggcatgggag tcagctgcac agtcaccggg gaagatggaa ccaatagcag 9120  
 atagggctgc cagtgaacca atcacatgat gtcaccaga catcaggcat acccactagt 9180  
 gtgaaataga catcagaatt aagaaaaacg tagggtccaa gtggttcccc gttatggact 9240  
 cgctatctgt caaccagatc ttataccccg aagttcacct agatagcccc atagttacca 9300  
 acaagatagt agccatcctg gagtatgctc gagtccctca cgcttacagc ctggaggacc 9360  
 ctacactgtg tcagaacatc aagcaccggc taaaaaacgg attttccaac caaatgatta 9420  
 taaacaatgt ggaagttggg aatgtcatca agtccaagct taggagttat ccggccact 9480  
 ctcatattcc atatccaaac tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540  
 cgaggaagat ccgtgaactc ctcaaaaagg gaaattcgct gtactctaaa gtcagtaata 9600  
 aggttttcca atgcttgagg gacactaatt cagggttggt tctaggctcc gaattgaggg 9660  
 aggacatcaa ggagaaagtt attaatctgg gagtttacat gcacagctcc caatggtttg 9720  
 agccctttct gttttggttt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780  
 cccatacttg ccataggagg agacacacac ctgtattctt cactggtagt tcagttgagt 9840  
 tgctaattct tcgtgacctt gttgctataa tcagtaaaga gtctcaacat gtatattacc 9900  
 taacatttga gctgggtttt atgtattgtg atgtcataga ggggaggtta atgacagaga 9960  
 ctgctatgac cattgatgct agatatacag agcttctagg aagagtcaga tacatgtgga 10020  
 aattgataga tggtttcttc cctgcactcg ggaatccaac ttatcaaatt gtagccatgc 10080  
 tggagcctct ttcacttgct tacctgcagc tgagggatat aacggtagaa ctgagagggtg 10140  
 ctttctttaa cactgcttt actgaaatac atgatgttct tgaccaaaac gggttttctg 10200  
 atgaaggtag ttatcacgag ttagttgaag ctctagatta cattttcata actgatgaca 10260  
 tacacctgac aggggagatt ttctcatttt tcagaagttt cggccacccc agacttgaag 10320  
 cagtaacggc tgctgaaaat gttaggaaat acatgaatca gcctaaagtc attgtgtatg 10380  
 agactctgat gaaaggatcat gccatatttt gtggaatcat aatcaacggc tatcgtgaca 10440  
 ggcacggagg cagttggcca ccgtgaccc tccccctgca tgctgcagac acaatccgga 10500  
 atgctcaagc ctcagggtgaa ggattaacac atgagcagtg cgttgataac tggaaatctt 10560  
 ttgctggagt gaaatttggc tgcttcatgc ctcttagcct ggatagtgat ctgacaatgt 10620  
 acctaaagga caaggcactt gctgctctcc aaagggaatg ggattcagtt taccgaaag 10680  
 agttcctgcg ttacgacccc ccaagggaag ccgggtcacg gaggcttga gatgttttcc 10740  
 ttaatgatcc gagctttgac ccatatgata tgataatgta tgttgtaagt ggagcttacc 10800  
 tccatgaccc tgagttcaac ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860  
 gtagactttt tgctaaaatg acttacaaaa tgagggcagc ccaagtgatt gctgaaaatc 10920  
 taatctcaaa cgggattggc aaatatttta aggacaatgg gatggccaag gatgagcacg 10980

atttgactaa ggcactccac actctggctg tctcaggagt ccctaaagat ctcaaagaaa 11040  
 gtcacagagg ggggccagtc ctaaaaacct actcccgaag cccagcccac acaaatacca 11100  
 ggaacgtgag ggcagcaaaa ggggtttatag ggttcctca gataattcgg caggaccaag 11160  
 aactaatca tccggagaat atggaagctt acgagacagt cagtgcattt atcacaactg 11220  
 atctcaagaa gtactgcctt aattggagat atgagaccat cagcttggtt gcacagaggc 11280  
 taaatgagat ttacggatta ccttcatttt ttcagtggct gcataagagg cttgagacct 11340  
 ctgtcctgta tgtaagtgtg cctcattgcc ccccgacct tgacgcccac atcccgttat 11400  
 gcaaagtccc caatgaccaa atcttcatta agtaccctat gggagggtata gaagggtatt 11460  
 gtcagaagct gtggaccatc agcaccattc cctattttata cctggctgct tatgagagcg 11520  
 gagtaaggat tgcttcatta gtgcaagggg acaatcagac catagctgta acaaaaaggg 11580  
 taccagcac atggccttac aaccttaaga aatgggaagc tgctagagta actagagatt 11640  
 actttgtaat tcttaggcaa aggtacatg acattggcca tcacctcaag gcaaatgaga 11700  
 caattgtttc atcacatttt tttgtttatt caaaaggaat atattatgat gggctacttg 11760  
 tgtccaatc actcaagagc atcgcaagat gtgtattctg gtcagagact atagttgatg 11820  
 aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagagggt 11880  
 atgaccgtta ccttgcatat tccctgaacg tcctaaaagt gatacagcag attctgatct 11940  
 ctcttggtt cacaatcaat tcaaccatga cccaggatgt agtcataccc ctctcacaa 12000  
 acaacgacct cttaataagg atggcactgt tgcccgctcc tattgggggg atgaattatc 12060  
 tgaatatgag caggctgttt gtcagaaaca tcggtgatcc agtaacatca tcaattgctg 12120  
 atctcaagag aatgattctc gcatcactga tgcctgaaga gaccctccat caagtaatga 12180  
 cacagcaacc gggggactct tcattcctag actgggctag cgacccttac tcagcaaatc 12240  
 ttgtatgtgt ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctaa 12300  
 tccacagtcc aaacccaatg ttaaagggat tattccatga tgacagtaaa gaagaggacg 12360  
 agggactggc agcattcctc atggacaggc atattatagt acctagggca gctcatgaaa 12420  
 tcctggatca tagtgtcaca ggggcaagag agtctattgc aggcattgcta gataccacaa 12480  
 aaggcctgat tcgagccagc atgaggaagg ggggggttaac ctctcgagtg ataaccagat 12540  
 tgtccaatta tgactatgaa caattcagag cagggatggt gctattaaca ggaagaaaga 12600  
 gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggcgagagcc ctaagaagcc 12660  
 atatgtgggc gaggctagct cgaggacggc ctatttacgg ccttgaggtc cctgatgtac 12720  
 tagaatctat gcgaggccac cttattcggc gtcattgagac atgtgtcatc tgcgagtgtg 12780  
 gatcagtcaa ctacggatgg ttttttgtcc cctcggttg ccaactggat gatattgaca 12840  
 aggaaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900  
 tgaagcttgc ctctgtaaga gcccgaagtc gatccttgcg atctgctgtt agaatagcaa 12960  
 cagtgtactc atgggcttac ggtgatgatg atagctcttg gaacgaagcc tgggtgttg 13020  
 caaggcaaag ggctaattgt agcctggagg agctaagggt gatcactccc atctcaactt 13080  
 cgactaattt agcacatagg ttgagggatc gtagcactca agtgaaatac tcagggtacat 13140  
 ccctgtccg agtggaagg tataccacaa tctccaacga caatctctca tttgtcatat 13200  
 cagataagaa ggttgatact aactttatat accaacaagg aatgctccta gggttggcg 13260  
 ttttagaaac attgtttcga ctcgagaaag ataccggatc atctaacacg gtattacatc 13320  
 ttacgtcga aacagattgt tgcgtgatcc caatgataga tcatcccagg ataccagct 13380  
 ctgcgaagct agagctgagg gcagagctgt gtaccaaccc attgatatat gataatgcac 13440  
 ctttaattga cagagatgca acaaggctat acaccagag ccataggagg caccttgtag 13500  
 aatttgttac atggtccaca ccccaactat atcacattct agctaagtcc acagcaactat 13560  
 ctatgattga cctggtaaca aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620  
 taggggatga cgatatcaat agtttcataa ctgagtttct gcttatagag ccaagattat 13680  
 tcactatcta cttgggccag tgtgcggcca tcaattgggc atttgatgta cattatcata 13740  
 gaccatcagg gaaatatcag atgggtgagc tgttgtcatc gttcctttct agaatagaca 13800  
 aaggagtgtt taagggtgct gtcaatgctc taagccaccc aaagatctac aagaattct 13860

```

ggcactgtgg tattatagag cctatccatg gtccttcact tgatgctcaa aacttgca 13920
caactgtgtg caacatgggt tacacatgct atatgacctt cctcgacctg ttgttgaatg 13980
aagagttaga agagttttaca tttcttttgt gtgaaagtga cgaggatgta gtaccggaca 14040
gattcgacaa catccaggca aaacacttgt gtgttctggc agatttgtac tgtcaaccag 14100
ggacctgccc accaattcga ggtctaagac cggtagagaa atgtgcagtt ctaaccgacc 14160
atatcaaggc ggaggctagg ttatctccag caggatcttc gtggaacata aatccaatta 14220
ttgtagacca ttactcatgc tctctgactt atcttcggcg aggatcgatc aaacagataa 14280
gattgagagt tgatccagga ttcattttcg acgccctcgc tgaggtaa at gtcagtcagc 14340
caaagatcgg cagcaacaac atctcaaata tgagcatcaa ggatttcaga cccccacacg 14400
atgatgttgc aaaattgctc aaagatatca atacaagcaa gcacaatctt cccatttctg 14460
ggggcaatct cgccaattat gaaatccatg ctttccgag aatcgggttg aactcatctg 14520
cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccagggggaag 14580
acggcttatt cttgggtgag ggatcgggtt ctatgttgat cacttataag gagatactta 14640
aactaaacaa gtgcttctat aatagtgggg tctctgcaa ttctagatct ggtcaaaggg 14700
aattagcacc ctatccctcc gaagtggcc ttgtcgaaca cagaatggga gtaggtaata 14760
ttgtcaagggt gctctttaac gggaggcccg aagtcacatg ggtaggcagt gtagattgct 14820
tcaattacat agttagta atccctacct ctagtgtggg gtttatccat tcagatatag 14880
agaccttacc taacaaagat actatagaga agctagagga attggcagcc atcttatcga 14940
tggctctgct cctgggcaaa ataggatcaa tactggtgat taagcttatg cctttcagcg 15000
gggattttgt tcagggattt ataagttatg tagggtctca ttatagagaa gtgaaccttg 15060
tataccccag atacagcaac ttcatatcta ctgaatctta tttggttatg acagatctca 15120
aggctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcactctgtg 15180
ggacttcacc tggacttata ggtcacatcc tatccattaa gcaactaagc tgcatacaag 15240
caattgtggg agacgcagtt agtagaggtg atatcaatcc tactctgaaa aaacttacac 15300
ctatagagca ggtgctgatc aattgcggtt tggcaattaa cggacctaaa ctgtgcaaag 15360
aattgatcca ccatgatgtt gcctcagggc aagatggatt gcttaattct atactcatcc 15420
tctacaggga gttggcaaga ttcaaggaca accaaagaag tcaacaaggg atgttccacg 15480
cttaccctcg attggtaagt agcaggcaac gagaacttat atctagaatc actcgcaaat 15540
tttgggggca cattctctt tactccggga acagaaagt gataaataag tttatccaga 15600
atctcaagtc cgttatctg atactagact tacaccagaa tatctctgtt aagaatctat 15660
ccaagtcaga gaaacagatt attatgacgg ggggtttgaa acgtgagtgg gtttttaagg 15720
taacagtcaa ggagaccaag gaatggtata agttagtcgg atacagtgcc ctgattaagg 15780
actaattggt tgaactccgg aaccctaata ctgccccagg tggtaggca ttatttgtaa 15840
tatattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

```

<210> 3

<211> 15894

<212> DNA

<213> Measles virus

<400> 3

```

accaaacaaa gttgggtaag gatagatcaa tcaatgatca tattctagta cacttaggat 60
tcaagatcct attatcaggg acaagagcag gattagggat atccgagatg gccacacttt 120
taaggagcct agcattgttc aaaagaaaca aggacaaacc acccattaca tcaggatccg 180
gtggagccat cagaggaatc aaacacatta ttatagtacc aatccctgga gattcctcaa 240
ttaccactcg atccagacta ctggaccggg tggtcagggt aattggaaac ccggatgtga 300
gcgggccccaa actaacaggg gcactaatag gtatattatc cttgtttgtg gagtctccag 360
gtcaattgat tcagaggatc accgatgacc ctgacgttag catcaggctg ttagaggttg 420

```

```

tccagagtga ccagtcacaa tctggcctta ccttcgcata aagaggtacc aacatggagg 480
atgaggcgga ccaatacttt tcacatgatg atccaagtag tagtgatcaa tccaggtccg 540
gatggttcga gaacaaggaa atctcagata ttgaagtgc aagacctgag ggattcaaca 600
tgattctggg taccattcta gcccaaattt gggctcttgc cgcgaaggcg gttacggccc 660
cagacacggc agctgattcg gagctaagaa ggtggataaa gtacacccaa caaagaaggg 720
tagttggtga attcagattg gagagaaaat ggttggatgt ggtgaggaac aggattgccc 780
aggacctctc cttacgccga ttcattggct ctctaatact ggatatcaag aggacacccc 840
ggaacaaacc aaggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900
gattagccag ttttatccta actattaagt ttgggataga aactatgtat cctgctcttg 960
gactgcatga atttgctggg gagttatcca cacttgagtc cttgatgaat ctttaccagc 1020
aatggggaga aactgcaccc tacatggtaa tcctggagaa ctcaattcag aacaagttca 1080
gtgcaggatc atacccctg ctctggagct atgccatggg agtaggggtg gaacttgaaa 1140
actccatggg aggtttgaac tttggctgat cttactttga tccagcatat tttagattag 1200
ggcaagagat ggtgaggagg tcagctggga aagtcagttc cacattagca tctgaactcg 1260
gtatcactgc tgaggatgca aggcttgttt cagagattgc aatgcacact actgaggaca 1320
ggaccagtag agcgggttga ccagacaaag cccaagtgtc atttctacac ggtgatcaaa 1380
gtgagaatga gctaccagga ttggggggca aggaagatag gaggggtcaa cagagtcggg 1440
gagaagccag ggagagctac agagaaaccc ggtctagcag agcaagcgat gcgagagctg 1500
cccatcttcc aaccagcgca cccttagaca ttgacactgc atcggagtca ggccaagatc 1560
cgcaggacag tcgacgggtc gctgacgccc tgctcaggct gcaagccatg gcaggaatct 1620
tggaagaaca aggtcagac acggacaccc ctagggtgta caatgacaga gatcttctag 1680
actaggtgcg agaggccgag gaccagaaca acatccgcct accctccatc attgttataa 1740
aaaacttagg aaccaggtcc acacagccgc cagccaacca accatccact cctacgactg 1800
gggccgatgg cagaagagca ggcacgccat gtcaaaaacg gactggaatg catccgggct 1860
ctcaaggccg agcccatcgg ctactggcc gtcgaggaag ccatggcagc atggtcacia 1920
atatcagaca acccaggaca ggaccgaacc acccgcaagg aagaggaggc aggcagttcg 1980
ggtctcagca aaccatgcct ctacgaatt ggatcaactg aaggcagtg acctcgcatc 2040
tgcggtcagg gatctggaga gagcgatgac aacgctgaaa ctttgggaat ccctcaaga 2100
aatctccagg catcaagcac tgggttacag tggttatcat tttatgatca cagcggtgaa 2160
gcgggttaag gaatccaaga tgctgactct atcatgggtt aatcaggcct tgatggtgat 2220
agcacctctc caggaggaga cgatgaatct gaaaacagcg atgtggatat tggcgaacct 2280
gataccgagg gatatgctat cactgaccgg ggatctgctc ccatctctat ggggttcagg 2340
gcttctgatg ttgaaactgc agaaggagg gagatccacg agctcctgag actccaatct 2400
agaggcaaca acttcccga gcttgggaaa actctcaatg ttctcgcgc cccgaacccc 2460
ggtagggcca gcacttccga gacacccatt aaaaagggga cagacgcgag attagcctca 2520
tttgagcgg agatcgctc tttattgaca ggtggtgcaa cccaatgtgc tcgaaagtca 2580
ccctcggaac catcagggcc aggtgcacct gtggggaatg tccccgagtg tgtgagcaat 2640
gccgactga tacaggagtg gacacccgaa tctggtacca caatctccc gagatcccag 2700
aataatgaag aagggggaga ttattatgat gatgagctgt tctccgatgt ccaagacatc 2760
aaaacagcct tggccaaaat acacaggat aatcagaaga taatctcaa gctagaatca 2820
ctgctgttat tgaagggaga agttgagtca attaaaaagc agatcaacag gcaaaatatc 2880
agcatatcca ccctggaagg acacctctca agcatcatga tcgccattcc tggacttggg 2940
aaggatccca acgacccac tgcagatgtc gaactcaatc ccgacctgaa acccatcata 3000
ggcagagatt caggccgagc actggccgaa gttctcaaga aacccgttgc cagccgacaa 3060
ctccaaggaa tgacaaatgg acggaccagt tccagaggac agctgctgaa ggaatttcaa 3120
ctaaagccga tcgggaaaaa gatgagctca gccgtcgggt ttgttctga caccggcccc 3180
gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240
cgttacctga tgactctcct tgatgatata aaaggagcca acgatcttgc caagttccac 3300

```

cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caacctcatg 3360  
 ccaatcgacc taattagtag agcctaaatc cattataaaa aacttaggag caaagtgatt 3420  
 gcctcccaag ttccacaatg acagagatct acgacttcga caagtcggca tgggacatca 3480  
 aagggtcgat cgctccgata caacctacca cctacagtga tggcaggctg gtgccccagg 3540  
 tcagagtcag agatcctggt ctaggcgaca ggaaggatga atgctttacg tacatgtttc 3600  
 tgctgggggt tgttgaggac agcgatcccc tagggcctcc aatcgggcga gcatttgggt 3660  
 ccctgccctt aggtgttgggt agatccacag caaaacccga agaactcctc aaagaggcca 3720  
 ctgagcttga catagtcgtt agacgtacag cagggctcaa tgaaaaactg gtgttctaca 3780  
 acaacacccc actaactctc ctcacacctt ggagaaaggt cctaacaaca gggagtgtct 3840  
 tcaacgcaaa ccaagtgtgc aatgcgggta atctgatacc gctggatacc ccgcagagggt 3900  
 tccgtgttgt ttatatgagc atcacccgtc tttcgataa cgggtattac accgttccta 3960  
 gaagaatgct agaattcaga tcgggtcaatg cagtggcttt caacctgctg gtgacctta 4020  
 ggattgacaa agcgattggc cctgggaaga tcatcgataa tgcagagcaa ctctctgagg 4080  
 caacatttat ggtccacatc gggaacttca ggagaaagaa gagtgaagtc tactctgctg 4140  
 attattgcaa aatgaaaatc gaaaagatgg gcctgggttt tgcacttgggt gggatagggg 4200  
 gcaccagtct tcacattaga agcacaggca aaatgagcaa gactctccat gcacaactcg 4260  
 ggttcaaaaa gaccttatgt taccactga tggatatcaa tgaagacctt aatcgattac 4320  
 tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagttcccc 4380  
 aagaattccg catttacgac gacgtgatca taaatgatga ccaaggacta ttcaaagttc 4440  
 tgtagaccgt agtgcccagc aataccgaa aacgaccccc ctcataatga cagccagaag 4500  
 gcccgacaa aaaagcccc tccaaaagac tccacggacc aagtgaagg ccagccagca 4560  
 gctgacggca agcgtgaaca ccaggcggcc tgggcacaga acagccccga cacaaggcaa 4620  
 ccaccagcca tcccaatctg cgtcctctc gtgggacccc cgaggacca cccccagggt 4680  
 cgccccgac ccagaccacc aaccgcatcc ccacagcccc cgggaaagag acccccagca 4740  
 actggaaggc ccctccccct ttccctcaac gcaagaactc cacaaccgaa ccgcacaagc 4800  
 gatcgagggtg acccaaccgc aggcattccga ctccctagac agatcctctc cccccggcaa 4860  
 actaaacaaa acttagggcc aaggaacata cacaccgac agaaccaga ccccggccca 4920  
 cggcgccgag cccccacctc ccgacaacca gagggagccc ccaaccaatc ccgcccgtc 4980  
 ccccggtgcc cacaggcagg cacaccaacc ctcgaaacaga ccagcaccc agccatcgac 5040  
 aattcaagac ggggggcccc ccccaaaaaa agggccccag gggccgacag ccagcaccgc 5100  
 gaggaagccc acccacccca cacacgacca caggaaccga accagaatcc agaccacct 5160  
 gggccaccag ttcccagact cggccatcac ccgcagaaa ggaaaggcca caaccgcgc 5220  
 acccctgccc tgatccggtg ggcggccacc caaccgaa cagcacccaa gagcgatccc 5280  
 cgaaggggcc ccgaaccgca aaagacatca gtatccaca gcctctccaa gtccccgggt 5340  
 ctccccctct tctcgaagg accaaaagat caatccacca caccgacga cactcaattc 5400  
 cccacccta aaggagacac cgggaatccc agaataaga ctcatccaat gtccatcatg 5460  
 ggtctcaagg tgaacgtctc tgccatattc atggcagtag tgttaactct ccaaacaccc 5520  
 accggtcaaa tccattgggg caatctctct aagatagggg tggtagggat aggaagtgc 5580  
 agctacaaag ttatgactcg ttccagccat caatcattag tcataaaatt aatgccaat 5640  
 ataactctcc tcaataactg cagcagggtg gagattgcag aatacaggag actactgaga 5700  
 acagttttgg aaccaattag agatgcactt aatgcaatga ccagaatat aagaccggtt 5760  
 cagagtgtag cttcaagtag gagacacaag agatttgctg gaggttgcct ggcgggtgcg 5820  
 gccctaggcg ttgccacagc tgctcagata acagccggca ttgcacttca ccagtccatg 5880  
 ttgaactctc aagccatcga caatctgaga gcgagcctgg aaactactaa tcaggcaatt 5940  
 gaggcaatca gacaagcagg gcaggagatg atattggctg ttcagggtgt ccaagactac 6000  
 atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaat cggccagaag 6060  
 ctagggtcga aattgctcag atactatata gaaatcctgt cactatttgg cccagctta 6120  
 cgggacccca tatctgcgga gatattctatc caggctttga gctatgcgct tggaggagat 6180



atcaataagg tgttagaaaa gctcggatac agtggagggtg atttactggg catcttagag 6240  
 agcagaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtactc 6300  
 agtatagcct atccgacgct gtccgagatt aaggggggtga ttgtccaccg gctagaaggg 6360  
 gtctcgtaca acataggctc tcaagagtgg tataccactg tgcccaagta tgttgcaacc 6420  
 caaggggtacc ttatctcgaa ttttgatgag tcatcgtgta ctttcatgcc agaggggact 6480  
 gtgtgcagcc aaaatgcctt gtacccgatg agtcctctgc tccaagaatg cctccggggg 6540  
 tccaccaagt cctgtgctcg tacacttgta tccgggtctt ttgggaaccg gttcatttta 6600  
 tcacaaggga atctaatagc caattgtgca tcaatccttt gcaagtgtta cacaacagga 6660  
 acgatcatta atcaggaccc tgacaagatc ctaacataca ttgctgccga tctctgcccg 6720  
 gtggtcgagg tgaacggcgt gaccatccaa gtcgggagca ggcggtatcc ggacgctgtg 6780  
 tacttgacac gaattgacct cggctcctccc atatcattgg agaggttgga cgtagggaca 6840  
 aatctgggga atgcaattgc taagttggag gatgccagg aattgttgga gtcacggac 6900  
 cagatattga ggagtatgaa aggtttatcg agcactagca tagtttacat cctgattgca 6960  
 gtgtgtcttg gagggttgat agggatcccc gctttaatat gttgctgcag gggcgctgtg 7020  
 aacaaaaagg gagaacaagt tggatgtgca agaccaggcc taaagcctga tcttacagga 7080  
 acatcaaaat cctatgtaag gtcgctctga tctctacaa ctcttgaaac acaaatgtcc 7140  
 cacaagtctc ctcttcgtca tcaagcaacc accgcatcca gcacgagcc cactgaaat 7200  
 tgtctccgga ttccctctgg ccgaacaata tcggtagtta attaaaactt agggtgcaag 7260  
 atcatccaca atgtcaccac aacgagaccg gataaatgcc ttctacaaag acaaccccca 7320  
 tcctagggga agtaggatag ttattaacag agaacatctt atgattgata gaccttatgt 7380  
 tttgtctggc gttctattcg tcatgtttct gagcttgatc gggttgctag ccattgcagg 7440  
 cataagactt catcgggcag ccactctacac cgcagagatc cataaaagcc tcagaccaa 7500  
 tctagatgta actaactcaa tcgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560  
 gatcatcggg gatgaagtgg gcctgaggac acctcagaga ttcaccgacc tagtgaatt 7620  
 catctctgac aagattaaat tccttaatcc ggatagggag tacgacttca gagatctcac 7680  
 ttggtgtatc aacccgccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740  
 ggctgctgaa gaactcatga atgcattggt gaactcaact ctactggagg ccagggtaac 7800  
 caatcagttc ctactgtctc caaagggaat ctgctcaggg ccactacaa tcagaggtca 7860  
 attctcaaac atgtcgtgtt cctgttgga ctgtatttta aatcgagggt acaatgtgtc 7920  
 atctatagtc actatgacat ccaggggaat gtacggggga acttacctag tggaaaagcc 7980  
 taatctgagc agtaaagggt cagagtgtgc acaactgagc atgcaccgag tgtttgaagt 8040  
 aggtgttatt agaaatccgg gtttgggggc tccggtgttc catatgacaa actattttga 8100  
 gcaaccagtc agtaatgatt tcagcaactg catggtggct ttgggggagc tcaaattcgc 8160  
 agccctttgt cacagggaag attctatcac aattccctat cagggatcag ggaaagggtg 8220  
 cagcttccag ctctgcaagc taggtgtctg gaaatcccca accgacatgc aatcctgggt 8280  
 cccctatca acggatgac cagtgataga caggctctac ctctcatctc acagaggcgt 8340  
 tatcgtgac aatcaagcaa aatgggctgt cccgacaaca cggacagatg acaagtgtcg 8400  
 aatggagaca tgctccagc aggcgtgtaa gggtaaaatc caagcactct gcgagaatcc 8460  
 cgagtgggca ccattgaagg ataacaggat tccttcatac ggggtcttgt ctgttaattc 8520  
 gagtctgaca gttgagctta aaatcaaaat tgcttcagga ttcgggcat tgatcacaca 8580  
 cggttcaggg atggacctat acaaatccaa ccacaacaat gtgtattggc tgactatccc 8640  
 gccaatgaag aacctagcct taggtgtaat caacacattg gagtggatac cgagattcaa 8700  
 ggtagtccc tacctcttca ctgttccaat taaggaagca ggcgaggact gccatgcccc 8760  
 aacataccta cctgcggagg tggatgggtga tgtcaaactc agttccaatc tgggtattct 8820  
 acctggtcaa gatctccaat atgttttggc aacctatgat acttcagag ttgaacatgc 8880  
 tgtggtttat tacgtttaca gcccagccg ctcatcttct tacttttctc cttttagggt 8940  
 gcctataagg ggggtcccca tcgaattaca agtggaatgc ttcacatggg accaaaaact 9000  
 ctggtgcgct cacttctgtg tgcttgcgga ctcagaatct ggtggatata tcaactcactc 9060

```

tgggatggtg ggcattgggag tcagctgcac agtcactcgg gaagatggaa ccaaccgcag 9120
atagggctgc cagtgaacca atcacatgat gtcacccaga catcaggcat acccactagt 9180
gtgaaataga catcagaatt aagaaaaacg taggggtccaa gtgggttcccc gttatggact 9240
cgctatctgt caaccagatc ttataccctg aagttcacct agatagcccg atagttacca 9300
ataagatagt agctatcctg gagtatgctc gagtccctca cgcatacagc ctggaggacc 9360
ctacactgtg tcagaacatc aagcaccgcc taaaaaacgg attttccaac caaatgatta 9420
taaacaatgt ggaagttggg aatgtcatca agtccaagct taggagttat ccgaccact 9480
ctcatattcc atatccaaat tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540
caaggaagat ccgtgagctc ctcaaaaagg gaaattcgct gtactccaaa gtcagtata 9600
aggttttcca atgcctgagg gacactaact cacggcttgg cctaggctcc gaattgagg 9660
aggacatcaa ggagaaaatt attaaacttg gagtttacct gcacagctcc caatgggttg 9720
agccctttct gttttgggtt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780
cccatacttg ccataggagg agacacacac cagtattctt cactggtagt tcagttgagt 9840
tgctaattctc tcgtgacctt gttgctataa tcagtaaaga gtctcaacat gtatattacc 9900
tgacgtttga actggctctg atgtattgtg atgtcataga ggggagggtta atgacagaga 9960
ccgctatgac cattgatgct aggtatacag agcttctagg aagagtcaga tacatgtgga 10020
aactgataga tgggtttctt cctgcactcg ggaatccaac ttaccaaatt gttagccatgc 10080
tggagcctct ttcacttgct tacctgcagc tgagggatat aacagtagaa ctgagaggtg 10140
ctttccttaa ccactgctt actgaaatac atgatgttct tgacccaaac ggggtttctg 10200
atgaaggtag ttatcatgag ttaattgaag ccctagatta cattttcata actgatgaca 10260
tacatctgac aggggagatt ttctcatttt tcagaagttt cggccacccc agacttgaag 10320
cagtaacggc tgctgaaaat gttaggaaat acatgaatca gcctaaagtc atttgttatg 10380
agactctgat gaaaggtagt gccatattct gtggaatcat aatcaacggc tatcgtgaca 10440
ggcacggagg cagttggcca cccctgaccc tccccctgca tgctgcagac acaatccgga 10500
atgctcaagc ttcagggtgaa ggggttaacac atgagcagtg cgttgataac tggaaatctt 10560
ttgctggagt gaaatttggt tgctttatgc ctcttagcct ggatagtgat ctgacaatgt 10620
acctaaagga caaggcactt gctgctctcc aaagggaatg ggattcagtt taccgaaag 10680
agttcctgct ttacgacctt ccaaaggaa ctgggtcacg gaggtctgta aatgttttcc 10740
ttaatgattc gagctttgac ccatatgaca tgataatgta tgttgtaagt ggagcttacc 10800
tccatgaccc tgagttcaac ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860
gtagactttt tgctaaaatg acttacaaaa tgagggtcatg ccaagtgatt gctgaaaatc 10920
taatctcaaa cgggattggc aattatttta aggacaatgg gatggccaag gacgagcacg 10980
atgtgactaa ggcactccac actctagctg tctcaggagt ccccaaagat ctcaaagaaa 11040
gtcacagggg ggggccagtc ttaaaaaccc actcccgaag ccagtcacac acaagtacca 11100
agaacgtgag agcagcaaaa ggggtttatag gattccctca tgtaattcgg caggaccaag 11160
acactgatca tccggagaat atggaggctt acgagacagt cagtgcattt atcacgactg 11220
atctcaagaa gtactgcctt aattggagat atgagacat cagcttattt gcacaaaggc 11280
taaattgagt ttacggatta ccctcatttt tccagtggct gcataagagg cttgaaacct 11340
ctgtcctcta tgtaagtgac cctcattgcc cccctgacct tgacgcccac gtcccgttat 11400
gcaaagtcac caatgaccaa atcttcatta agtaccctat gggagggtata gaagggtatt 11460
gtcagaagct gtggaccatc agcaccattc cctatttata cctggctgct tatgagagcg 11520
gagtaaggat tgcttcgtta gtgcaagggg acaatcagac catagccgta acaaaaaggg 11580
taccagcac atggccttac aaccttaaga aacgggaagc tgctagagta actagagatt 11640
actttgtaat tcttaggcaa aggtacatg acataggcca tcacctcaag gcaaatgaga 11700
caattgtctc atcacatttt tttgtctatt caaaaggaat atattatgat gggctacttg 11760
tgtcccaatc actcaagagc atcgcaagat gtgtattctg gtcagagact atagttgatg 11820
aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagagggt 11880
atgaccgtta ccttgcatat tccctgaacg tcctaaagat gatacagcaa atcctgatct 11940

```

```

ctcttggtt cacaatcaat tcaaccatga cccgggatgt agtcataccc ctctcacao 12000
acaacgatct ctaataaagg atggcactgt tgcccgctcc tatcgggggg atgaattatc 12060
tgaatatgag caggctgttt gtcagaaaca tcggtgatcc agtaacatca tcaattgctg 12120
atctcaagag aatgattctc tcatcactaa tgctgaaga gacccttcat caagtaatga 12180
cacaacaacc gggggactct tcattcctag actgggctag cgacccttac tcagcaaatc 12240
ttgtatgctg ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctga 12300
tccatagtcc aaacccaatg ttaaaagggt tattccatga tgacagtaaa gaagaggacg 12360
agggactggc ggcatctctc atggacaggc atattatagt acctagggca gctcatgaaa 12420
tcctggatca tagtgtcaca ggggcaagag agtctattgc aggcattgta gataccacao 12480
aaggcctgat tcgagccagc atgaggaagg gggggttaac ctctcgagtg ataaccagat 12540
tgtccaatta tgactatgaa caatttagag cagggatggg gctattgaca ggaagaaaga 12600
gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggctagagcc ctaagaagcc 12660
atatgtgggc aaggctagct cgaggacggc ctatttacgg ccttgaggtc cctgattgac 12720
tagaatctat gcgaggccac ctattcggc gccatgagac atgtgtcatc tgcgagtgtg 12780
gatcagtcaa ctacggatgg tttttgtcc cctcgggttg ccaactggat gatattgaca 12840
aggaaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900
tgaagcttgc cttcgttaaga gcccgaagtc gatccttgcg atctgctgtt agaatagcaa 12960
cagtgtactc atgggcttat ggtgatgatg atagctcttg gaacgaagcc tgggtgttg 13020
caaggcaaag ggccaatgtg agcctggagg agctaagggt gatcactccc atctcaactt 13080
cgactaattt agcgcatagg ttgagggatc gtaccactca agtgaaatac tcaggtagat 13140
cccttgctcg agtggcaagg tataccacao tctccaacga caatctctca tttgtcatat 13200
cagataagaa ggttgatact aactttatat accaacaggg aatgcttcta ggggtgggtg 13260
ttttagaaac attgtttcga ctcgagaaag ataccggatc atctaacacg gtattacatc 13320
ttcacgtcga aacagattgt tgcgtgatcc cgatgataga tcatcccagg ataccagct 13380
cccgcaagct agagcttagg gcagagctat gtaccaaccc attgatatat gataatgcac 13440
ctttaattga cagagatgca acaaggctat acaccagag ccataggagg caccttgttg 13500
aatttgttac atggtccaca ccccaactat atcacatctt agctaagtcc acagcactat 13560
ctatgattga cctggttaaca aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620
taggggatga cgatatcaat agtttcataa ctgagtttct gcttatagag ccaagattat 13680
tcactatcta cttggggccag tgtgcagcca tcaattgggc atttgatgta cattatcata 13740
gaccatcagg gaaatatcag atgggtgagc tgttgtcttc gttcctttct agaattgagca 13800
aaggagtgtt taagggtgct gtcaatgtct taagccaccc aaagatctac aagaaattct 13860
ggcattgttg tattatagag cctatccatg gtccttcact tgatgctcaa aacttacaca 13920
caactgtgtg caacatgatt tacacatgct atatgacct cctcgacctg ttgttgaatg 13980
aagagttaga agagttcaca tttcttctgt gtgaaagcga cgaggatgta gtaccggaca 14040
gattcgacaa tatccaggca aaacacttgt gtgttctagc agatttgtac tgtcaaccag 14100
ggacctgccc accaattcga ggtctacgac ctgtagagaa atgtgcagtt ctaaccgac 14160
atatcaaggc agaggctagg ttatctccag cagggtcttc gtggaacata aatccaatta 14220
ttgtagacca ttactcatgc tctctgactt atctccggcg aggatcgatc aaacagataa 14280
gattgagagt tgatccagga ttcatttttg acgcccctgc tgaggtaaat gtcagtgcac 14340
caaagatcgg cagcaacaac atctcaaata tgagcatcaa ggatttcaga cctccacacg 14400
atgatgttgc aaaattgtct aaagatatca acacaagcaa gcacaatctt cccatttcag 14460
ggggtaatct cgccaattat gaaatccacg ctttccgcag aatcggggta aactcatccg 14520
cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccaggggaag 14580
acggcttgtt cttgggtgag gggtcgggtt ctatgttgat cacttataag gagatactaa 14640
aactaaacaa gtgcttctat aatagtggg tttccgccaa ttctagatct ggtcaaagg 14700
aattagcacc ctatccctcc gaagttggtc ttgtcgaaca cagaatggga gtaggtaata 14760
ttgtcaaagt gctctttaac gggaggcccg aagtacgtg ggtaggcagt gtagattgct 14820

```

```

tcaatttcat agtcagtaat atccctacct ctagtggtggg gtttatccat tcagatatag 14880
agaccttacc taacaaagat actatagaga agctagagga attagcagcc atcttatcga 14940
tggtctctgct ccttggcaaa ataggatcaa tactggtgat taagcttatg cctttcagcg 15000
gggattttgt tcagggattt ataagttatg taggggtctta ttatagagaa gtgaaccttg 15060
tctaccctag atacagcaac ttcatatcta ctgaatctta tttagtcag acagatctca 15120
aagctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcactctgtgc 15180
ggacttcacc tggacttata ggtcacatcc tatccattaa gcaactaagc tgcatacaag 15240
caattgtggg agacgcagtt agtagagggt gtatcaaccc tattctgaag aaacttacac 15300
ctatagagca ggtgctgatc aattgcggtt tggcaattaa cggacctaaa ctgtgcaaag 15360
aattgatcca ccatgatgtt gcctcagggc aagatggatt gcttaactct atactcatcc 15420
tctacagggg gttggcaaga ttcaaagaca accaaagaag tcaacaaggg atgttccatg 15480
cttaccctcg attggttaagt agcaggcaac gagaacttat atctaggatc acccgcaaat 15540
tttgggggca tattcttctt tactccggga acagaaagtt gataaatcgg tttatccaga 15600
atctcaagtc cggttacctg atactagact tacaccagaa tatcttcggt aagaatctat 15660
ctaagtcaga gaaacagatt attatgacgg ggggttttaa acgtgagtggt gtttttaagg 15720
taacaatcaa ggagaccaa gaatggtata agttagtcgg atacagtgcc ctgattaagg 15780
attaattggt tggactccgg gaccctaata ctgccctagg tagttaggca ttatttgcaa 15840
tatattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

```

<210> 4

<211> 15894

<212> DNA

<213> Measles virus

<400> 4

```

accaaacaaa gttgggtaag gatagatcaa tcaatgatca tattctagta cacttaggat 60
tcaagatcct attatcaggg acaagagcag gattagggat atccgagatg gccacacttt 120
tgaggagctt agcattgttc aaaagaaaca aggacaaacc acccattaca tcaggatccg 180
gtggagccat cagaggaatc aaacacatta ttatagtacc aattcctgga gattcctcaa 240
ttaccactcg atccagacta ctggaccggt tggtcaggtt aattggaaac ccggatgtga 300
gcgggcccaa actaacaggg gcactaatag gtatattatc cttatttgtg gagtctccag 360
gtcaattgat tcagaggatc accgatgacc ctgacgttag catcaggctg ttagagggtt 420
ttcagagtga ccagtcacaa tctggcctta ccttcgcata aagaggtagc aacatggagg 480
atgaggcgga ccaatacttt tcacatgatg atccaagcag tagtgatcaa tccagggtcc 540
gatggttcga gaacaaggaa atctcagata ttgaagtgcg agatcctgag ggattcaaca 600
tgattctggg taccattcta gccagatctt gggctcttgc cgcaaaggcg gttacggccc 660
cagacacggc agctgattcg gagctaagaa ggtggataaa gtacaccaa caaagaaggg 720
tagttggtga atttagattg gagagaaaat ggttggatgt ggtgaggaa aggattgccg 780
aggacctctc tttacgccga ttcattggtg ctctaactct ggatatcaag aggacaccg 840
ggaacaaacc taggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900
gattagccag ttttatcttg actattaagt ttgggataga aactatgtat cctgctcttg 960
gactgcatga atttgcctgg gagttatcca cacttgagtc cttgatgaat ctttaccagc 1020
aatggggaga aactgcaccc tacatggtta tcctagagaa ctcaattcag aacaagttca 1080
gcgagggatc ataccctctg ctctggagct atgccatggg agtaggagtg gaacttgaaa 1140
actccatggg aggtttgaac tttggctgat cttactttga tccagcatat tttagattag 1200
ggcaagagat ggtgaggagg tcagctggaa aggtcagttc cacattggca tccgaactcg 1260
gtatcactgc cgaggatgca aggcttggtt cagagattgc aatgcatact actgaggaca 1320
ggatcagtag agcggctcga cccagacaag cccaagtatc atttctacac ggtgatcaaa 1380

```

gtgagaatga gctaccagga ttggggggca aggaagacag gaggggtcaaa cagagtcggg 1440  
 gagaagccag ggagagctac agagaaaccg agtccagcag agcaagtgat gcgagagctg 1500  
 cccatcctcc aaccagcatg cccctagaca ttgacactgc atcggagtca ggccaagatc 1560  
 cgcaggacag tcgaagggtca gctgacgctc tgctcaggct gcaagccatg gcaggaatct 1620  
 tggaagaaca aggtcagac acggacaccc ctagggtata caatgacaga gatcttctag 1680  
 attaggtgcg agaggccgag gaccagaaca acatccgct accctccatc attgttataa 1740  
 aaaacttagg aaccaggtcc acacagccgc cagccaacca accatccact cccacgactg 1800  
 gagccgatgg cagaagagca ggcacgcat gtcaaaaacg gactggaatg catccgggct 1860  
 ctcaaggccg agcccatcgg ctactggcc gtcgaggaag ccatggcagc atggtcagaa 1920  
 atatcagaca atccaggaca ggaccgagcc gcctgcaagg aagaggaggc aggcagtctg 1980  
 ggtctcagca aaccatgctt ctacgaatt ggatcaactg aaggcgggtg acctcgcatc 2040  
 cgcggtcagg gatctggaga aagcgatgac gacgtgaaa ctttgggaat cccctcaaga 2100  
 aatctccagg catcaagcac tgggttacag tgttatcatg tttatgatca cagcggtgaa 2160  
 gcgggttaagg gaatccaaga tgctgactct atcatgggtc aatcaggcct tgatggtgat 2220  
 agcaccctct caggaggaga cgatgaatct gaaaacagcg atgtggatat tggcgaaact 2280  
 gataccgagg gatatgctat cactgaccgg ggatctgctc ccatctctat ggggttcagg 2340  
 gcttctgatg ttgaaactgc agaaggagg gagatccacg agtcctgaa actccaatcc 2400  
 agaggcaaca actttccgaa gcttgggaaa actctcaatg ttctccgcc ccgaacccc 2460  
 agtagggcca gcacttccga gacacccatt aaaaagggga cagacgcgag attggcctca 2520  
 tttggaacgg agatcgcgtc ttattgaca ggtggtgcaa cccaatgtgc tcgaaagtca 2580  
 ccctcggaac cgtcagggcc agatgcacct gcggggaatg tccccgagtg tgtgagcaat 2640  
 gccgactga tacaggagtg gacacccgaa tctggtacca caatctccc gagatcccag 2700  
 aataatgaag aagggggaga ctattatgat gatgagctgt tctccgatgt ccaagacatc 2760  
 aaaacagcct tggccaaaat acacgaggat aatcagaaga taatctccaa gctagaatca 2820  
 ttgctgttat tgaagggaga agttgagtca attaagaagc agatcaacag gcaaaatatc 2880  
 agcatatcca ccctggaagg acacctctca agcatcatga ttgccattcc tggacttggg 2940  
 aaggatccca acgacccac tgcatgtgc gaactcaatc ccgacctgaa acccatcata 3000  
 ggcagagatt caggccgagc actggccgaa gttctcaaga agccggtgc cagccgacaa 3060  
 ctccaggga tgactaatgg acggaccagt tccaggagac agctgctgaa ggaatttcaa 3120  
 ctaaagccga tcgggaaaaa ggtgagctca gccgtcgggt ttgtccctga caccggcct 3180  
 gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240  
 cgttacctgt tgactctcct tgatgatata aaaggagcca acgatcttgc caagttccac 3300  
 cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caaccccatg 3360  
 ccagtcgacc taattagtag aacctaaatc cattataaaa aacttaggag caaagtgatt 3420  
 gcctcctaag ttccacaatg acagagatct acgacttcca caagtcggca tgggacatca 3480  
 aagggtcgat cgctccgata caacctacca cctacagtga tggcaggctg gtgccccagg 3540  
 tcagagtcac agatcctggg ctagggtgata ggaaggatga atgctttatg tacatgtttc 3600  
 tgctgggggt tgttgaggac agagatcccc tagggcctcc aatcgggcca gcattcgggt 3660  
 ccctgcctt aggtgttggg agatccacag caaaacccga ggaactcctc aaagaggcca 3720  
 ctgagcttga catagtgtt agacgtacag cagggtcaa tgaaaaactg gtgttctaca 3780  
 acaacacccc actaacctc ctacacctt ggagaaagg cctaacaaca gggagtgtct 3840  
 tcaatgcaaa ccaagtgtgc aatgcggtta atctaatacc gctggacacc ccgagagggt 3900  
 tccgtgttgt ttatatgagc atcaccgctc ttccggataa cgggtattac accgttccca 3960  
 gaagaatgct ggaattcaga tcggtcaatg cagtggcctt caacctgcta gtgacctca 4020  
 ggattgacaa ggcgattggc cctgggaaga tcatcgacaa tgcagagcaa cttcctgagg 4080  
 caacatttat ggtccacatc ggaacttca ggagaaagaa gagtgaagtc tactctgccg 4140  
 attattgcaa aatgaaaatc gaaaagatgg gcctggtttt tgcacttggg gggatagggg 4200  
 gcaccagtct tcacattaga agcacaggca aaatgagcaa gactctccat gcacaactcg 4260

ggttcaagaa gaccttatgt taccactga tggatatcaa tgaagacctt aatcggttac 4320  
 tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagttcctc 4380  
 aagaattccg catttacgac gacgtgatca taaatgatga ccaaggacta ttcaaagtcc 4440  
 tgtagaccgt agtccccagc aataccgaa aacgaccccc ctcataatga cagccagaag 4500  
 gcccggacaa aaaagcccc tccaaaagac ttcacggacc aagcgagagg ccagccagca 4560  
 gccgacagca agtgtggaca ccaggcggcc caagcacaga acagccccga cacaaggcca 4620  
 ccaccagcca tcccaatccg cgtcctcctc gtaggacccc cgaggaccaa cccccaaggt 4680  
 cgctccggac acagaccacc agccgcatcc ccacagccct cgggaaagga acccccagca 4740  
 actggaaggc cccttcccc ctcccccaac gcaagaaccc cacaaccgaa ccgcacaagc 4800  
 gaccgagggtg acccaaccgc aggcattccga ctccctagac agaccctccc tccccggcat 4860  
 actaaacaaa acttagggcc aaggaaacaca cacaccgac agaaccaga ccccgcccg 4920  
 cggcaccgag cccccacccc ccgaaaacca gagggagccc ccaaccaatc ccgcccggcc 4980  
 ccccggtgcc cacaggtagg cacaccaacc ccgaacaga ccagcacc agccaccgac 5040  
 aatccaagac ggggggcccc ccccaaaaaa aggccccag gggccgacag ccagcatcgc 5100  
 gaggaagccc acccacccca cacacgacca cggcaaccaa accagagccc agaccacct 5160  
 gggccaccag ctcccagact cggccatcac cccgaaaaaa ggaaaggcca caaccgcgc 5220  
 accccaggcc cgatccggcg ggaagccacc caaccgaac cagcacccaa gagcgatccc 5280  
 tgggggaccc ccaaaccgca aaagacatca gtatccacc gcctctccaa gtccccgggt 5340  
 ctctcctct tctcgaagg accaaaagat caatccacca catccgacga cactcaattc 5400  
 cccacccta aaggagacac cgggaatccc agaatcaaga ctcatccaat gtccatcatg 5460  
 ggtctcaagg tgaatgtctt tgccatattc atggcagtag tgttaactct ccaaacaccc 5520  
 accggtcaaa tccattgggg caatctctct aagatagggg tggtagggat aggaagtgc 5580  
 agctacaaag ttatgactcg ttccagccat caatcattgg tcataaaatt aatgcccaat 5640  
 ataactctcc tcaataactg cacgagggtg gaaattgcag aatacaggag actactgaga 5700  
 acagttttgg aaccaattag agatgcactt aatgcaatga ccagaatat aagaccggtt 5760  
 cagagtgtag cttaagtag gagacacaag agatttgccg gagttgtcct ggcaggtgcg 5820  
 gccctaggcg ttgccacagc tgctcagata acagccggca ttgcacttca ccagtcctatg 5880  
 ctgaactctc aagccatcga caatctgaga gcaagcctgg aaactactaa tcaggcaatt 5940  
 gaggcaatca ggcaagcagg gcaggagatg atattggctg ttcagggtgt ccaagactac 6000  
 atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaat cggccagaag 6060  
 ctagggtcga aattgtcag atactataca gaaatcctgt cattatttgg cccagctta 6120  
 cgggacccca tatctgcgga gatattccatc caggcttga gctatgcgct tgggggagat 6180  
 atcaataagg tattagaaaa gctcggatac agtggagggtg atttactggg catcttagag 6240  
 agcagaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtcctc 6300  
 agtatagcct atccgacgct gtccgagatt aaggggtga ttgtccaccg gctagagggg 6360  
 gtctcgta atataggctc tcaagagtgg tataccactg tgccaagta tgttgcaacc 6420  
 caagggtacc ttatctcgaa ttttgatgag tcatcgtgta ctttcatgcc agaggggact 6480  
 gtgtgcagcc aaaatgcctt gtaccgatg agtcctctgc tccaagaatg cctccggggg 6540  
 tccaccaagt cctgtgctcg tacactcgta tccgggtctt ttgggaaccg gttcatttta 6600  
 tcacaaggga acctaatagc caattgtgca tcaatcctct gcaagtgtta cacaacagga 6660  
 acgatcatta atcaagaccc tgacaagatc ctaacataca ttgctgccga tctgccccg 6720  
 gtggtcgagg tgaacgggtg gaccatccaa gtcgggagca ggaggtatcc ggacgcggtg 6780  
 tacctgcaca gaattgacct cggctcctcc atatcattgg agaagttgga cgtagggaca 6840  
 aatctgggga atgcaattgc taagctggag gatgccaagg aattgctgga gtcacggac 6900  
 cagatatatg ggagtatgaa aggtttatcg agcactagca tagtttacat cctgattgca 6960  
 gtgtgtcttg gagggttgat agggatcccc gctttaatat gttgctgcag ggggcgttgt 7020  
 aacaaaaagg gggaacaagt tggatatgca agaccaggcc taaagcctga tcttacaggg 7080  
 acatcaaaat cctatgtaag gtcgctctga tcccctacaa ctcttgaaac acagatttcc 7140

cacaagtctc ctctccgtca tcaagcaacc accgcatcca gcatcaaggc caccgaaat 7200  
tgtctccggc ttccctctgg ccgaacgata tcggtagtta attaaaactt aggggtgcaag 7260  
atcatccaca atgtcaccac accgagaccg aataaatgcc ttctacaaag acaaccccc 7320  
tcctaaggga agtaggatag ttattaacag agaacatctt atgattgata gaccttatgt 7380  
tttgctggct gttctattcg tcatgtttct gagcttgatc ggggtgctag ccattgcagg 7440  
cattagactc catcgggcag ccactacac cgcagagatc cataagagcc tcagcaccaa 7500  
tctagatgta actaactcaa tcgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560  
gatcatcggg gatgaagtgg gcctgaggac acctcagaga ttactgacc tagtgaaatt 7620  
catctctgac aaaattaaat tccttaatcc ggatagggag tacgacttca gagatctcac 7680  
ttggtgtatc aaccgccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740  
ggctgctgaa gaactcatga atgcattggg gaactcaact ctactggagg ccagggaac 7800  
caatcagttc ctagctgtct caaagggaac ctgctcaggc ccactacaa tcagaggtca 7860  
attctcaaac atgtcgctgt ccctgttggg cttgtattta agtcgaggtt acaatgtgtc 7920  
atctatagtc accatgacat ccaggggaat gtacggggga acttacctag tgggaaagcc 7980  
taatctgagc agtaaagggt cagagtgtgc acaactgagc atgcaccgag tgtttgaagt 8040  
aggggttctc agaaatccgg gtttgggggc tccggtgttc catatgacaa actattttga 8100  
gcaaccagtc agtaatgatt tcagcaactg catggtggct ttgggggagc tcaggttcgc 8160  
agccctctgt cacagggaag attctgtcac ggttccctat caggggtcag ggaaagggtg 8220  
cagcttcocag ctctcaagc taggtgtctg gaaatcccca accgacatgc aatcctgggt 8280  
ccccctatca acggatgatc cagtgataga taggctttac ctctcatctc acagaggtgt 8340  
tatcgctgac aatcaagcaa atgggctgt cccgacaaca cggacagatg acaagtgcg 8400  
aatggagaca tgctccagc aggcgtgtaa gggtaaaaac caagcactct gcgagaatcc 8460  
cgagtgggca ccattgaagg ataacaggat tccttcatac ggggtcttgt ctgttaatct 8520  
gagtctgaca gttgagctta aaatcaaat tgcttcagga ttccggccat tgatcacaca 8580  
cggttcaggg atggacctat acaaaaccaa ccacaacaat gtgtattggc tgactatccc 8640  
gccaatgaag aacctagcct taggtgtaat caacacattg gagtggatac cgagattcaa 8700  
ggtagtccc aacctcttca ctgttccaat caaggaagca ggcgaggact gccatgccc 8760  
aacataccta cctcgaggag tggatggtga tgtcaaaactc agttccaatc tggtaattct 8820  
acctggtcag gatctccaat atgttttggc aacctacgat acttcagggt ttgaacatgc 8880  
tgtggtttat tatgtttaca gccaggccg ctcatcttct tacttttctc cttttaggtt 8940  
gcctataaag ggggtcccaa tcgaattaca agtggaaatgc ttcacatggg accaaaaact 9000  
ctggtgcctg cacttctgtg tgcttgcgga ttcagaatct ggtggacata tcaactcctc 9060  
tgggatgggt ggcatgggag tcagctgcac agtcactcgg gaagatggaa ccaatcgag 9120  
atagggctgc cagtgaaccg atcacatgat gtcactcaga caccaggeat acccactagt 9180  
gtgaaataga catcagaatt aagaaaaacg taggggtcaa gtggtttccc gtcatggact 9240  
cgctatctgt caaccagatc ttgtaccctg aagttcacct agatagcccg atagttacca 9300  
ataagatagt agctatcctg gagtatgtct gagtcctca cgcttacagc cttgaggacc 9360  
ctacactgtg tcagaacatc aagcacccgc taaaaaacgg attctccaac caaatgatta 9420  
taaacaatgt ggaagtggg aatgtcatca agtccaagct taggagttat ccggccact 9480  
ctcatattcc atatccaaat tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540  
caaggaagat ccgtgagctc ctaaaaaagg gaaattcgct gtactccaaa gtcagtata 9600  
aggttttcca atgcctgagg gacactaact cagggttggt cctaggctcc gaattgagg 9660  
aggacatcaa ggagaaaatt attacttggt gagtttacct gcacagctcc caatggttg 9720  
agccctttct gttttgggtt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780  
cccatacttg ccataggagg agacacacac ctgtattctt cactggtagt tcagttgagc 9840  
tgttaatctc tcgtgacctt gttgctataa tcagtaagga gtctcaacat gtatattacc 9900  
tgacgtttga actgggtttg atgtattgtg atgtcataga ggggaggtta atgacagaga 9960  
ccgctatgac cattgatgct aggtatgcag aacttctagg aagagtcaga tacatgtgga 10020

```

aactgataga tggtttcttc cctgcactcg ggaatccaac ttatcaaatt gtagctatgc 10080
tggagccact ttcacttgct tacctgcaac tgagggacat aacagtagaa ctacagaggtg 10140
ctttccttaa ccaactgcttt actgaaatac atgatgttct tgacccaaac gggttttctg 10200
atgaaggtag ttatcatgag ttaattgaag ccttagatta cattttcata actgatgaca 10260
tacatctgac aggggagatt ttctcatttt tcagaagttt cggccacccc agacttgaag 10320
cagtaacggc tgctgaaaat gtcaggaaat acatgaatca gcctaaagtc attgtgtatg 10380
agactctgat gaagggtcat gccatatttt gtggaatcat aatcaacggc tatcgtgaca 10440
ggcacggagg cagttggcca cccctgaccc tccccctgca tgctgcagac acaatccgga 10500
atgctcaagc ttcaggtgaa gggttaacac atgagcagtg cggtgataac tggagatcat 10560
ttgctggagt gagatttggc tgttttatgc ctcttagcct ggacagtgat ctgacaatgt 10620
acctaaagga caaggcactt gctgctctcc aaagggaatg ggattcagtt taccggaaag 10680
agttcctgcg ttacgatcct cccaaggga cccgggtcacg gaggcttgta gatgttttcc 10740
ttaatgattc gagctttgac ccatatgata tgataatgta tgcgtgaagt ggagcctacc 10800
tccatgaccc tgagttcaat ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860
gtagactttt cgctaaaatg acttacaaaa tgagggcatg ccaagtgatc gctgaaaatc 10920
taatctcaaa cgggattggc aagtatttta aggacaatgg gatggccaag gatgagcacg 10980
atgtgactaa ggcactccac actctggctg tctcaggagt ccccaaagat ctcaaagaaa 11040
gtcacagggg ggggcccagtc ttaaaaacct actcccgaag cccagtcac acaagtacca 11100
ggaacgttaa agcagaaaaa gggttttag gatccctca tgtaattcgg cagaatcaag 11160
acactgatca tccggagaat atagaaacct acgagacagt cagcgcattt atcacgactg 11220
atctcaagaa gtactgcctt aattggagat atgagaccat cagcttattt gcacagaggc 11280
taaatgagat ttacggatta cctcattttt ttcagtggct gcataagagg cttgaaacct 11340
ctgtcctcta tgtaagtgat cctcattgcc ccccgacct tgacgcccac gtcccgttat 11400
gcaaagtccc caatgaccaa atcttcatca agtaccctat gggagggtata gaagggtatt 11460
gtcagaagct gtggaccatc agcaccattc cctacttata cctggctgct tatgagagcg 11520
gggtaaggat tgctcgtta gtgcaagggg acaatcagac catagccgta acaaaaaggg 11580
taccagcac atggccttac aaccttaaga aacgggaagc tgctagagta actagagatt 11640
actttgtaat tcttaggcaa aggctacatg acattggcca tcacctcaag gcaaatgaga 11700
caattgtttc atcacatttt tttgtctatt caaaaggaa atattatgat gggctacttg 11760
tgtcccaatc actcaagagc attgcaagat gtgtattctg gtcagagact atagttgatg 11820
aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagaggtt 11880
atgaccgtta tcttgcatat tccctgaacg tccataaaagt gatacagcaa attttgatct 11940
ctcttggtct cacaatcaat tcaacctga cccgagatgt agtcataccc ctctcacia 12000
acaacgatct cttaataagg atggcactgt tgcccgtctc tattgggggg atgaattatc 12060
tgaacatgag caggctgttt gtcagaaaca tcgggtgatcc agtaacatca tcaattgctg 12120
atctcaagag aatgattctc gcatcactaa tgctgaaga gaccctccat caagtaatga 12180
cacaacaacc gggggactct tcattcctag actgggctag cgacccttac tcagcaaadc 12240
ttgtatgcgt ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctaa 12300
tccatagtcc aaaccaatg ttaaaagggt tattccatga tgacagtaaa gaagaggacg 12360
agagactggc ggcattcctc atggacaggc atattatagt acctagggca gctcatgaaa 12420
tcttgatca tagtgtcaca ggggcaagag agtctattgc aggcagtgta gataccacia 12480
aaggcctgat tcgagccagc atgaggaagg ggggggtaac ctctcgatg ataaccagat 12540
tgtccaatta tgactatgaa caatttagag cagggatggg gctattgaca ggaagaaaaga 12600
gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggctagagcc ctaagaagcc 12660
atatgtgggc aagactagct cgaggacggc ctatttacgg ccttgaggtc cctgatgtac 12720
tagaatctat gcgaggccac ctatttcggc gtcatgagac atgtgtcatc tgcgagtggt 12780
gatcagtcac ctacggatgg tttttgtcc cctcgggttg ccaactggat gatattgaca 12840
aggaaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900

```



tgaagcttgc cttcgtaaga gcccgaagta gatccttgcg atctgccgtt agaataagcaa 12960  
 cagtgtactc atgggcttac ggtgatgatg atagctcttg gaacgaagcc tggttggttg 13020  
 caaggcaaaag ggccaatgtg agcctggagg agctaagggt gatcactccc atctogactt 13080  
 cgactaattt agcgcatagg ttgagggatc gtagcactca agtgaaatac tcagggtacat 13140  
 cccttgctcag agtggcaagg tataccacaa tctccaacga caatctctca tttgtcatat 13200  
 cagataagaa agttgatact aactttatat accaacaagg aatgcttcta gggttgggtg 13260  
 ttttagaaac attgtttcga ctcgagaaag atactggatc atctaacacg gtattacatc 13320  
 ttcacgtcga aacagattgt tgcgtgatcc cgatgataga tcatcccagg ataccagct 13380  
 cccgcaagct agagctgagg gcagagctat gtaccaaccc attgatatat gataatgcac 13440  
 ctttaattga cagagatgca acaaggctat acaccagag ccataggagg caccttgttg 13500  
 aatttggttac atgggccaca ccccaactat atcacattct agctaagtcc acagcactat 13560  
 ctatgattga cctggtaaca aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620  
 taggggatga cgatatcaat agtttcataa ctgagtttct gcttatagag ccaagattat 13680  
 tcaccatcta cttgggccag tgtgcagcca tcaattgggc atttgatgta cattatcata 13740  
 gaccatcagg gaaatatcag atgggtgagc tgttgtcttc gttcctttct agaagagca 13800  
 aaggagtgtt taagggtgct gtcaatgctc taagccaccc aaagatctac aagaaattct 13860  
 ggcattgtgg tattatagag cctatccatg gtccttctact tgatgctcaa aacttgca 13920  
 caactgtgtg caacatggtt tacacatgct atatgacctt ccttgacctg ttgttgaatg 13980  
 aagagttaga agagttcaca tttcttttgt gtgaaagcga tgaggatgta gtaccggaca 14040  
 gattcgacaa catccaggca aaacacttgt gtgttctggc agatttgta tgtcaaccag 14100  
 ggacctgcc accgattcga ggtctaaggc cggtagagaa atgtgcagtt ctaaccgatc 14160  
 atatcaaggc agaggctagg ttatctccag caggatcttc gtggaacata aatccaatta 14220  
 ttgtagacca ttactcatgc tctctgactt atctccgtcg aggatctatc aaacagataa 14280  
 gattgagagt tgatccagga ttcatttttg atgccctcgc tgaggtaaatt gtcagtcagc 14340  
 caaaggctcg cagcaacaac atctcaaata tgagcatcaa ggatttcaga cctccacacg 14400  
 atgatgttgc aaaattgctc aaagatatca acacaagcaa gcacaatctt cccatttcag 14460  
 ggggtagtct tgccaattat gaaatccatg ctttccgcag aatcgggtta aactcatctg 14520  
 cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccaggggaag 14580  
 acggcttggt cttgggtgag gggtcgggtt ctatgttgat cacttataag gagatactaa 14640  
 aactaaacaa gtgcttctat aatagtgggg tttccgccaa ttctagatct ggtcaaaggg 14700  
 aattagcacc ctatccctcc gaagttggcc ttgtcgaaca cagaatggga gtaggtaata 14760  
 ttgtcaaggt gctctttaac gggaggcccg aagtcacgtg ggtaggcagt atagattgct 14820  
 tcaatttcat agtcagtaat atccctacct ctagtgtggg atttatccat tcagatatag 14880  
 agaccttacc caacaaagat actatagaga agttagagga attggcagcc atcttatcga 14940  
 tggtctact ccttggcaaa ataggatcaa tactggtgat taagcttatg cctttcagcg 15000  
 gggattttgt tcagggattt ataagctatg taggggtctca ttatagagaa gtgaaccttg 15060  
 tctaccctag gtacagcaac ttcatatcta ctgaatctta tttagttagt acagatctca 15120  
 aagctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcatctgtgc 15180  
 ggacttcacc tggacttata ggtcacatcc tatctatcaa gcaactaagc tgcatacaag 15240  
 caattgtggg aggcgcagtt agtagaggtg atatcaacc tattctgaaa aaacttacac 15300  
 ctatagagca ggtgctgac agttgcggtt tggcaattaa cggacctag ctgtgcaaag 15360  
 aattaatcca ccatgatgtt gcctcagggc aagatggatt gcttaactct atactcatcc 15420  
 tctacaggga gttggcaaga ttcaaagaca accaaagaag tcaacaaggg atgttccacg 15480  
 cttaccccggt attggtaagt agtaggcaac gagaacttgt atctaggatc actcgcaaat 15540  
 tttgggggca tattcttctt tactccggga acagaaagtt gataaatcgg tttatccaga 15600  
 atctcaagtc cggttatcta atactagact tacaccagaa tatcttcggt aagaatctat 15660  
 ccaagtcaga gaaacagatt attatgacgg ggggtttaa acgtgagtg gtttttaagg 15720  
 taacagtcaa ggagaccaa gaatggtata agttagtcgg atacagcgct ctgattaagg 15780

attaattggt tgaactccgg aaccctaatac ctaccctagg tagttaggca ttatttgcaa 15840  
 tatattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

<210> 5

<211> 15894

<212> DNA

<213> Measles virus

<400> 5

accaaacaaa gttgggtaag gatagttcaa tcaatgatca tcttctagtg cacttaggat 60  
 tcaagatcct attatcaggg acaagagcag gattagggat atccgagatg gccacacttt 120  
 taaggagctt agcattgttc aaaagaaaca aggacaaacc acccattaca tcaggatccg 180  
 gtggagccat cagaggaatc aaacacatta ttatagtacc aatccctgga gattcctcaa 240  
 ttaccactcg atccagactt ctggaccggg tggtcagggt aattggaaac ccggatgtga 300  
 gcggggcccaa actaacaggg gcactaatag gtatattatc cttatttgtg gagtctccag 360  
 gtcaattgat tcagaggatc accgatgacc ctgacgttag cataaggctg ttagagggtg 420  
 tccagagtga ccagtcacaa tctggcctta ccttcgcac aagaggtagc aacatggagg 480  
 atgaggcgga ccaatacttt tcacatgatg atccaattag tagtgatcaa tccaggttcg 540  
 gatggttcga gaacaaggaa atctcagata ttgaagtga agacctgag ggattcaaca 600  
 tgattctggg taccatccta gcccacattt gggctctgct cgcaaaggcg gttacggccc 660  
 cagacacggc agctgattcg gagctaagaa ggtggataaa gtacacccaa caaagaaggg 720  
 tgggttggtga atttagattg gagagaaaat ggttggtatg ggtgaggaaac aggattgccg 780  
 aggacctctc cttacgccga ttcattggct ctctaactct ggatatcaag agaacacccg 840  
 gaaacaaacc caggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900  
 gattagccag ttttatcctg actattaagt ttgggataga aactatgtat cctgctcttg 960  
 gactgcatga atttgctggg gagttatcca cacttgagtc cttgatgaac ctttaccagc 1020  
 aaatggggga aactgcaccc tacatggtaa tcctggagaa ctcaattcag aacaagttca 1080  
 gtgcaggatc ataccctctg ctctggagct atgccatggg agtaggagtg gaacttgaaa 1140  
 actccatggg aggtttgaac tttggccgat cttactttga tccagcatat tttagattag 1200  
 ggcaagagat ggtaaggagg tcagctggaa aggtcagttc cacattggca tctgaactcg 1260  
 gtatcactgc cgaggatgca aggcttggtt cagagattgc aatgcatact actgaggaca 1320  
 agatcagtag agcggttgga cccagacaag cccaagtatc atttctacac ggtgatcaaa 1380  
 gtgagaatga gctaccgaga ttgggggggca aggaagatag gaggggtcaa cagagtcgag 1440  
 gagaagccag ggagagctac agagaaaccg ggcccagcag agcaagtgat gcgagagctg 1500  
 cccatcttcc aaccggcaca cccctagaca ttgacactgc aacggagtcc agccaagatc 1560  
 cgcaggacag tcgaaggcca gctgacgccc tgcttaggct gcaagccatg gcaggaatct 1620  
 cggaagaaca aggtcagac acggacaccc ctatagtgtg caatgacaga aatcttctag 1680  
 actaggtgag agaggccgag ggccagaaca acatccgcct accctccatc attgttataa 1740  
 aaaacttagg aaccagggtc acacagccgc cagcccatca accatccact cccacgattg 1800  
 gagccaatgg cagaagagca ggcacgccat gtcaaaaacg gactggaatg catccgggct 1860  
 ctcaaggccg agcccatcgg ctactggcc atcgaggaag ctatggcagc atggtcagaa 1920  
 atatcagaca acccaggaca ggagcgagcc acctgcaggg aagagaaggc aggcagttcg 1980  
 ggtctcagca aaccatgcct ctacgaatt ggatcaactg aaggcgggtg acctcgcatc 2040  
 cgcggtcagg gacctggaga gagcgatgac gacgctgaaa ctttgggaat cccccaaga 2100  
 aatctccagg catcaagcac tgggttacag tggtattacg tttatgatca cagcggtgaa 2160  
 gcgggttaagg gaatccaaga tgctgactct atcatgggtc aatcaggcct tgatgggtgat 2220  
 agcaccctct caggaggaga caatgaatct gaaaacagcg atgtggatat tggcgaacct 2280  
 gataccgagg gatatgctat cactgaccgg ggatctgctc ccatctctat ggggttcagg 2340

gcttctgatg ttgaaactgc agaaggaggg gagatccacg agctcctgag actccaatcc 2400  
 agaggcaaca actttccgaa gcttgggaaa actctcaatg ttctccgcc cccggacccc 2460  
 ggtagggccca gcacttccgg gacacccatt aaaaaggcca cagacgcgag attagcctca 2520  
 tttggaacgg agatcgctgc tttattgaca ggtggtgcaa cccaatgtgc tcgaaagtca 2580  
 ccctcggaac catcaggggc aggtgcacct gcggggaatg tccccgagtg tgtgagcaat 2640  
 gccgactga tacaggagtg gacacccgaa tctggtacca caatctccc gagatcccag 2700  
 aataatgaag aagggggaga ctattatgat gatgagctgt tctctgatgt ccaagatatt 2760  
 aaaacagcct tggccaaaat acacgaggat aatcagaaga taatctccaa gctagaatca 2820  
 ctgctgttat tgaagggaga agttgagtca attaagaagc agatcaacag gcaaaatatc 2880  
 agcatatcca ccctggaagg acacctctca agcatcatga tcgccattcc tggacttggg 2940  
 aaggatccca acgacccac tgcagatgtc gaaatcaatc ccgacttgaa acccatcata 3000  
 ggcagagatt caggccgagc actggccgaa gttctcaaga aaccctgtgc cagccgacaa 3060  
 ctccaaggaa tgacaaatgg acggaccagt tccagaggac agctgctgaa ggaatttcag 3120  
 ctaaagccga tcgggaaaaa gatgagctca gccgtcgggt ttgttctga caccggccct 3180  
 gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240  
 cgttacctga tgactctcct tgatgatata aaaggagcca atgatcttgc caagttccac 3300  
 cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caaccccatg 3360  
 ccagtgcacc caactagtac aacctaaatc cattataaaa aacttaggag caaagtgatt 3420  
 gcctcccaag ttccacaatg acagagacct acgacttcca caagtcggca tgggacatca 3480  
 aagggtcgat cgctccgata caacccacca cctacagtga tggcaggctg gtgccccagg 3540  
 tcagagtcac agatcctggg ctaggcgaca ggaaggatga atgctttatg tacatgtttc 3600  
 tgctgggggt tggtgaggac agcgattccc tagggcctcc aatcgggcga gcatttgggt 3660  
 ccctgccctt aggtgttggc agatccacag caaagcccg aaaaactctc aaagaggcca 3720  
 ctgagcttga catagtgtt agacgtacag cagggtcaa tgaaaaactg gtgttctaca 3780  
 acaacacccc actaactctc ctcacacctt ggagaaaggt cctaacaaca gggagtgtct 3840  
 tcaacgcaaa ccaagtgtgc aatgcggtta atctgatacc gctcgatacc ccgcagaggt 3900  
 tccgtgttgt ttatatgagc atcacccgtc tttcggataa cgggtattac accgttcta 3960  
 gaagaatgct ggaattcaga tcggtcaatg cagtggcctt caacctgctg gtgacctta 4020  
 ggattgacaa ggcgatagcc cctgggaaga tcatcgacaa tacagagcaa ctctctgagg 4080  
 caacatttat ggtccacatc gggaaacttca ggagaaagaa gagtgaagtc tactctgccg 4140  
 attattgcaa aatgaaaatc gaaaagatgg gcctggtttt tgcacttggg gggatagggg 4200  
 gcaccagtct tcacattaga agcacaggca aaatgagcaa gactctccat gcacaactcg 4260  
 ggttcaagaa gaccttatgt taccgctga tggatatcaa tgaagacctt aatcgattac 4320  
 tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagttctc 4380  
 aagaattccg catttacgac gacgtgatca taaatgatga ccaaggacta ttcaaagttc 4440  
 tgtagaccgt agtgcaccg aatgcccga aacgaccccc ctcaaatga cagccagaag 4500  
 gcccgacaa aaaagcccc tccgaaagac tccacggacc aagcgagagg ccagccagca 4560  
 gccgacggca agcggaaca ccaggcgcc ccagcacaga acagccccga cacaaggcca 4620  
 ccaccagcca cccaatctg catcctctc gtgggacccc cgaggaccaa cccaaggcc 4680  
 tgccccgat ccaaaccacc aaccgcatcc ccaccacccc cgggaaagaa acccccagca 4740  
 attggaaggc cctccccct ctctctcaac acaagaactc cacaaccgaa ccgcacaagc 4800  
 gaccgaggtg acccaaccgc aggcaccca ctccctagac agatcctctc tccccggcaa 4860  
 actaaacaaa acttagggcc aaggaacata cacaccaac agaaccaga ccccgccca 4920  
 cggcgccgcg cccccaaccc ccgacaacca gagggagccc ccaaccaatc ccgcccgtc 4980  
 ccccggtgcc cacaggcagg gacaccaacc cccgaacaga ccagcacc aaccatcgac 5040  
 aatccaagac gggggggccc ccccaaaaa agggccccag gggccgacag ccagcaccgc 5100  
 gaggaagccc acccacccca cacacgacca cggcaaccaa accagaaccc agaccacct 5160  
 gggccaccag ctcccagact cggccatcac cccgcagaaa ggaaaggcca caacccgcgc 5220

```

acccagccc cgatccggcg gggagccacc caaccgaac cagcacccea gagcgatccc 5280
cgaaggaccc ccgaaccgca aaggacacca gtatcccaca gcctctccaa gtcccccggt 5340
ctctctctct tctcgaaggg accaaaagat caatccacca caccgcagca cactcaactc 5400
cccacccta aaggagacac cgggaatccc agaatcaaga ctcatccaat gtccatcatg 5460
ggctctcaagg tgaacgtctc tgccatattc atggcagtac tgtaactct ccaaaccacc 5520
accggtcaaa tccattgggg caatctctct aagatagggg tggtaggaat aggaagtgc 5580
agctacaaag ttatgactcg ttccagccat caatcattag tcataaaatt aatgcccatt 5640
ataactctcc tcaataactg cagcagggtg gagattgcag aatacaggag actactgaga 5700
acagttttgg aaccaattag agatgcactt aatgcaatga cccagaatat aagaccggtt 5760
cagagtgtag cttcaagtag gagacacaag agatttgccg gagtagtcct ggcagggtgcg 5820
gccctaggcg ttgccacagc tgctcagata acagccggca ttgcacttca ccagtccatg 5880
ctgaactctc aagccatcga caatctgaga gcgagcctgg aaactactaa tcaggcaatt 5940
gaggcaatca gacaagcagg gcaggagatg atattggctg ttcagggtgt ccaagactac 6000
atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaatt cggccagaag 6060
ctcgggctca aattgctcag atactataca gaaatcctgt cattatttgg cccagttta 6120
cgggacccca tatctgcgga gatattctatc caggctttga gctatgcgct tggaggagac 6180
atcaataagg tggtagaaaa gctcggatag agtggagggtg atttactggg catcttagag 6240
agcggaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtctc 6300
agtatagcct atccgacgct gtccgagatt aaggggggtg ttgtccaccg gctagagggg 6360
gtctcgtaac acataggctc tcaagagtgg tataccactg tgcccaagta tggtagcaacc 6420
caagggtacc ttatctcgaa ttttgatgag tcatcgtgta ctttcatgcc agaggggact 6480
gtgtgcagcc aaaatgcctt gtaccgcatg agtcctctgc tccaagaatg cctccggggg 6540
tacaccaagt cctgtgctcg taccctcgta tccgggtctt ttgggaaccg gttcatttta 6600
tcacaaggga acctaatagc caattgtgca tcaatccttt gcaagtgtta cacaacagga 6660
acgatcatta atcaagaccc tgacaagatc ctaacataca ttgctgccga tcaactgccg 6720
gtagtcgagg tgaacggcgt gatcatccaa gtcgggagca ggaggatatc agacgctgtg 6780
tacttgcaac gaattgacct cggctctccc atatcattgg agagggttga cgtagggaca 6840
aatctgggga atgcaattgc taagtgtgag gatgccaaag aattgttga gtcacggac 6900
cagatattga ggagtatgaa aggtttatcg agcactagca tagtctacat cctgattgca 6960
gtgtgtcttg gaggttgat agggatcccc gctttaatat gttgctgcag ggggctgtgt 7020
aacaanaagg gagaacaagt tggtagtca agaccaggcc taaagcctga tcttacggga 7080
acatcaaaat cctatgtaag gtcgctctga tctctacaa ctcttgaaac acaaatgtcc 7140
cacaagtctc ctcttcgtca tcaagcaacc accgcacca gcatcaagcc cacctgaaat 7200
tatctccggc ttccctctgg ccgaacaata tcggtagtta attaaaactt aggggtgcaag 7260
atcatccaca atgtcaccac aacgagaccg gataaatgcc ttctacaaag ataaccccca 7320
tccaaggga agtaggatag tattaacag agaactctt atgattgata gaccttatgt 7380
tttgctggct gttctgtttg tcatgtttct gagcttgatc ggggttgctag ccattgcagg 7440
cattagactt catcgggcag ccactctacac cgcagagatc cataaaagcc tcagcaccac 7500
tctagatgta actaactcaa tcgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560
aatcatcggg gatgaagtgg gcctgaggac acctcagaga ttcactgacc tagtgaatt 7620
catctctgac aagattaaat tccttaatcc ggataggagac tacgacttca gagatctcac 7680
ttggtgtatc aacccgccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740
ggctgctgaa gagctcatga atgcattggg gaactcaact ctactggaga ccagaacaac 7800
caatcagttc ctagctgtct caaagggaac ctgctcaggg cccactacaa tcagaggtca 7860
attctcaaac atgtcgctgt ccctgttaga cttgtattta ggtcgagggt acaatgtgtc 7920
atctatagtc actatgacat cccaggggaat gtatggggga acttacctag tggaaaagcc 7980
taatctgagc agcaaaaggc cagagttgtc acaactgagc atgtaccgag tgtttgaagt 8040
aggtgttatc agaaatccgg gtttgggggc tccggtgttc catatgacaa actatcttga 8100

```

gcaaccagtc agtaatgata tcagcaactg tatgggtggct ttggggggagc tcaaactcgc 8160  
 agccctttgt cacggggaag attctatcac aattccctat cagggatcag ggaaagggtg 8220  
 cagcttcag ctcgtcaagc taggtgtctg gaaatcccca accgacatgc aatcctgggt 8280  
 ccccttatca acggtatgac cagtgataga caggctttac ctctcatctc acagagggtg 8340  
 tatcgctgac aatcaagcaa aatgggctgt cccgacaaca cgaacagatg acaagttgctg 8400  
 aatggagaca tgcttccaac aggcgtgtaa gggtaaaatc caagcactct gcgagaatcc 8460  
 cgagtgggca ccattgaagg ataacaggat tccttcatac ggggtcttgt ctgttgatct 8520  
 gagtctgaca gttgagctta aaatcaaaat tgcttcggga ttcgggccat tgatcacaca 8580  
 cggttcaggg atggacctat acaaatccaa ccacaacaat gtgtattggc tgactatccc 8640  
 gccaatgaag aacctagcct taggtgtaat caacacattg gagtggatc cgagattcaa 8700  
 ggtagtccc tacctcttca ctgtcccaat taagggaagca ggcaagact gccatgcccc 8760  
 aacataccta cctgcggagg tggatgggta tgtcaaaact agttccaatc tgggtgattct 8820  
 acctggtaaa gatctccaat atgttttggc aacctacgat acttcagggt ttgaacatgc 8880  
 tgtggtttat tacgtttaca gcccaagccg ctcatcttct tacttttctc cttttagggt 8940  
 gcctataaag ggggtcccca tcgaattaca agtggaatgc ttcacatggg accaaaaact 9000  
 ctgggtccgt cacttctgtg tgcttgccga ctcagaatct ggtggacata tcactcactc 9060  
 tgggatgggt ggcaggggag tcagctgcac agtcaccggg gaagatggaa ccaatcgag 9120  
 atagggtgct tagtgaacca atcacatgat gtcacccaga catcaggcat acccactagt 9180  
 gtgaaataga catcagaatt aagaaaaacg taggggtccaa gtgggtccccc gttatggact 9240  
 cgctatctgt caaccagatc ttataccctg aagttcacct agatagcccg atagttacca 9300  
 ataagatagt agccatcctg gagtatgctc gagtccctca cgcttacagc ctggaggacc 9360  
 ctacactgtg tcagaacatc aagcacccgc taaaaaacgg attttccaac caaatgatta 9420  
 taaacaatgt ggaagttggg aatgtcatca agtccaagct taggagttat cgggccact 9480  
 ctcatattcc atatccaaat tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540  
 cgaggaagat ccgtgaactc ctcaaaaagg ggaattcgct gtactccaaa gtcagtgata 9600  
 aggttttcca atgcttaagg gacactaact cacggcttgg cctaggctcc gaattgaggg 9660  
 aggacatcaa ggagaaagt attaacttgg gagtttacct gcacagctcc cagtgggttg 9720  
 agccctttct gttttgggtt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780  
 cccatacttg ccataggagg agacacacac ctgtattctt cactggtagt tcagttgagt 9840  
 tgctaactct tcgtgacctt gttgctataa tcagtaaaga gtctcaacat gtatattacc 9900  
 tgacatttga actgggtttg atgtattgtg atgtcataga ggggagggtta atgacagaga 9960  
 ccgctatgac tattgatgct aggtatacag agcttctagg aagagtcaga tacatgtgga 10020  
 aactgataga tgggttcttc cctgcactcg ggaatccaac ttatcaaatt gtagccatgc 10080  
 tggagcctct ttcacttgct tacctgcagc tgagggatat aacagtagaa ctcagagggtg 10140  
 ctttccttaa ccactgcttt actgaaatac atgatgttct tgacaaaaac ggggtttctg 10200  
 atgaaggtac ttatcatgag ttaattgaag ctctagatta cattttcata actgatgaca 10260  
 tacatctgac aggggagatt ttctcatttt tcagaagttt cgccaccccc agacttgaag 10320  
 cagtaacggc tgctgaaaat gttaggaaat acatgaatca gcctaaagtc atttgtgatg 10380  
 agactctgat gaaaggtcat gccatatttt gtggaatcat aatcaacggc tatcgtgaca 10440  
 ggcacggagg cagttggcca ccgctgaccc tccccctgca tgctgcagac acaatccgga 10500  
 atgctcaagc ttcaggtgaa gggttaacac atgagcagtg cgttgataac tggaaatctt 10560  
 ttgctggagt gaaatttggc tgctttatgc ctcttagcct ggatagtgat ctgacaatgt 10620  
 acctaaagga caaggcactt gctgctctcc aaagggaatg ggattcagtt taccgaaaag 10680  
 agttcctgct ttacgaccct cccaaggga cggggtcacg gaggttgta gatgttttcc 10740  
 ttaatgattc gagctttgac ccatatgatg tgataatgta tgttgtaagt ggagcttacc 10800  
 tccatgaccc tgagttcaac ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860  
 gtagactttt tgctaaaatg acttacaaaa tgaggggcatg ccaagtgatt gctgaaaatc 10920  
 taatctcaaa cgggattggc aaatatttta aggacaatgg gatggccaag gatgagcacg 10980

```

atttgactaa ggcactccac actctagctg tctcaggagt ccccaaagat ctcaaagaaa 11040
gtcacagggg ggggccagtc ttaaaaacct actcccgaag cccagtcacac acaagtacca 11100
ggaacgtgag agcagcaaaa gggtttatag ggttccctca agtaattcgg caggaccaag 11160
acactgatca tccggagaat atggaagctt acgagacagt cagtgcattt atcacgactg 11220
atctcaagaa gtactgcctt aattggagat atgagaccat cagcttggtt gcacagaggc 11280
taaattgagat ttacggattg ccttcatttt tccagtggct gcataagagg cttgagacct 11340
ctgtcctgta tgtaagtgac cctcattgcc ccccgacct tgacgccat atcccgttat 11400
ataaagtccc caatgatcaa atcttcatta agtaccctat gggagggtata gaagggtatt 11460
gtcagaagct gtggaccatc agcaccattc cctatctata cctggctgct tatgagagcg 11520
gagtaaggat tgcttcgtta gtgcaagggg acaatcagac catagccgta acaaaaaggg 11580
taccagcac atggccctac aaccttaaga aacgggaagc tgctagagta actagagatt 11640
actttgtaat tcttaggcaa aggtacatg atattggcca tcacctcaag gcaaattgaga 11700
caattgtttc atcacatttt tttgtctatt caaaaggaat atattatgat gggctacttg 11760
tgtcccaatc actcaagagc atcgcaagat gtgtattctg gtcagagact atagttgatg 11820
aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagagggt 11880
atgaccgtta ccttgcatat tccctgaacg tcctaaaagt gatacagcaa attctgatct 11940
ctcttggtt cacaatcaat tcaaccatga cccgggatgt agtcataccc ctctcaca 12000
acaacgacct cttaataagg atggcactgt tgcccgctcc tattgggggg atgaattatc 12060
tgaatatgag caggctgttt gtcagaaaca tcggtgatcc agtaacatca tcaattgctg 12120
atctcaagag aatgattctc gcctcactaa tgccctgaaga gacctccat caagtaatga 12180
cacaacaacc gggggactct tcattcctag actgggctag cgaccttac tcagcaaate 12240
ttgtatgtgt ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctga 12300
tccatagtcc aaaccaatg ttaaaaggat tattccatga tgacagtaaa gaagaggacg 12360
agggactggc ggcattcctc atggacaggc atattatagt acctagggca gctcatgaaa 12420
tcttgatca tagtgtcaca ggggcaagag agtctattgc aggcattgctg gataccacaa 12480
aaggcttgat tcgagccagc atgaggaagg ggggggttaac ctctcgagtg ataaccagat 12540
tgtccaatta tgactatgaa caattcagag cagggatggt gctattgaca ggaagaaagc 12600
gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggcgagagct ctaagaagcc 12660
atatgtgggc gaggctagct cgaggacggc ctatttacgg ccttgaggtc cctgatgtac 12720
tagaatctat gcgaggccac cttattcggc gtcattgagac atgtgtcatc tgcgagtgtg 12780
gatcagtcaa ctacggatgg ttttttgtcc cctcgggttg ccaactggat gatattgaca 12840
aggaaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900
tgaagcttgc cttcgttaaga gcccgaagtc gatccttgcg atctgctgtt agaatagcaa 12960
cagtgtactc atgggcttac ggtgatgatg atagctcttg gaacgaagcc tgggtgttg 13020
ctaggcaaaag ggccaatgtg agcctggagg agctaagggt gatcactccc atctcaactt 13080
cgactaattt agcgcatagg ttgagggatc gtagcactca agtgaaatac tcagggtacat 13140
cccttgccg agtggcgagg tataccacaa tctccaacga caatctctca tttgtcatat 13200
cagataagaa ggttgatact aactttatat accaacaagg aatgcttcta ggggtgggtg 13260
ttttagaac attgtttcga ctcgagaaag ataccggatc atctaacacg gtattacatc 13320
ttcacgtcga aacagattgt tgctgatcc cgatgataga tcatcccagg ataccagct 13380
ccgcaagct agagctgagg gcagagctat gtaccaaccc attgatatat gataatgcac 13440
ctttaattga cagagatgca acaaggctat acaccagag ccataggagg caccttggtg 13500
aatttggtac atggtccaca ccccaactat atcacatttt agctaagtcc acagcactat 13560
ctatgattga cctggttaaca aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620
taggggatga cgatatcaat agtttcataa ctgagtttct gctcatagag ccaagattat 13680
tcactatcta cttgggcccag tgtgcggcca tcaattgggc atttgatgta cattatcata 13740
gaccatcagg gaaatatcag atgggtgagc tgtgtcatc gttcctttct agaattgagca 13800
aaggagtgtt taagggtgctt gtcaatgctc taagccaccc aaagatctac aagaaattct 13860

```

```

ggcattgtgg tattatagag cctatccatg gtccttcact tgatgctcaa aacttgcaca 13920
caactgtgtg caacatgggt tacacatgct atatgacctt cctcgacctg ttgttgaatg 13980
aagagttaga agagttcaca tttctcttgt gtgaaagcga cgaggatgta gtaccggaca 14040
gattcgacaa catccaggca aaacacttat gtgttctggc agatttgtac tgtaaccag 14100
ggacctgccc accaattcga ggtctaagac cggtagagaa atgtgcagtt ctaaccgacc 14160
atatcaaggc agaggctatg ttatctccag caggatcttc gtggaacata aatccaatta 14220
ttgtagacca ttactcatgc tctctgactt atctccggcg aggatcgatc aaacagataa 14280
gattgagagt tgatccagga ttcattttcg acgccctcgc tgaggtaa at gtcagtcagc 14340
caaagatcgg cagcaacaac atctcaaata tgagcatcaa ggctttcaga ccccccacacg 14400
atgatgttgc aaaattgctc aaagatatca acacaagcaa gcacaatctt cccatttcag 14460
ggggcaatct cgccaattat gaaatccatg ctttccgcag aatcggttg aactcatctg 14520
cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccaggggagg 14580
acggcttgtt cttgggtgag ggatcggtt ctatgttgat cacttataag gagatactta 14640
aactaaacaa gtgttcttat aatagtggg tttccgcaa ttctagatct ggtcaaagg 14700
aattagcacc ctatccctcc gaagtggcc ttgtcgaaca cagaatggga gtaggtaata 14760
ttgtcaaagt gctctttaac gggaggcccg aagtcacgtg ggtaggcagt gtagattgct 14820
tcaatttcat agttagtaat atccctacct ctagtgtggg gtttatccat tcagatatag 14880
agaccttgcc tgacaaagat actatagaga agctagagga attggcagcc atcttatcga 14940
tggtctctgct cctgggcaaa ataggatcaa tactggtgat taagcttatg cctttcagcg 15000
gggattttgt tcagggattt ataagttatg taggggtctca ttatagagaa gtgaaccttg 15060
tataccctag atacagcaac ttcatctcta ctgaatctta tttgggttatg acagatctca 15120
aggctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcatctgtga 15180
ggacttcacc tggacttata ggtcacatcc tatccattaa gcaactaagc tgcatacaag 15240
caattgtggg agacgcagtt agtagagggtg atatcaatcc tactctgaaa aaacttacac 15300
ctatagagca ggtgctgac aattgcgggt tggcaattaa cggacctag ctgtgcaaag 15360
aattgatcca ccatgatgtt gcctcagggc aagatggatt gcttaattct atactcatcc 15420
tctacaggga gttggcaaga ttcaaagaca accaaagaag tcaacaaggg atgttccacg 15480
cttaccctcg attggttaagt agcaggcaac gagaacttat atctaggatc acccgcaa at 15540
tctgggggca cattcttctt tactccggga acagaaagtt gataaataag tttatccaga 15600
atctcaagtc cggtatctg atactagact tacaccagaa tatcttcgtt aagaatctat 15660
ccaagtcaga gaaacagatt attatgacgg ggggtttgaa acgtgagtg gtttttaagg 15720
taacagtc aa ggagaccaa gaatgggtata agttagtcgg atacagtgc ctgattaagg 15780
actaattggt tgaactccgg aaccctaate ctgcctagg tggtaggca ttatttgc aa 15840
tatattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

```

<210> 6

<211> 15894

<212> DNA

<213> Measles virus

<400> 6

```

accaaacaaa gttgggtaag gatagttcaa tcaatgatca tcttctagt cacttaggat 60
tcaagatcct attatcaggg acaagagcag gattagggat atccgagatg gccacacttt 120
taaggagcct agcattgttc aaaagaaaca aggacaaacc acccattaca tcaggatccg 180
gtggagccat cagaggaatc aaacacatta ttatagtacc aatccctgga gattctctaa 240
ttaccactcg atccagactt ctggaccggg tggtagagggt aattggaaac ccggatgtga 300
gcgggcccaa actaacaggg gcactaatag gtatattatc cttatttgtg gagtctccag 360
gtcaattgat tcagaggatc accgatgacc ctgacgttag cataaggctg ttagagggtg 420

```

tccagagtga ccagtcacaa tctggcctta ccttcgcatc aagaggtacc aacatggagg 480  
 atgaggcgga ccaatacttt tcacatgatg atccaattag tagtgatcaa tccagggttcg 540  
 gatgggttcgg gaacaaggaa atctcagata ttgaagtgc aagacctgag ggattcaaca 600  
 tgattctggg taccatccta gcccaaattt gggctcttgc cgcaaaggcg gttacggccc 660  
 cagacacggc agctgattcg gagctaagaa ggtggataaa gtacacccaa caaagaaggg 720  
 tagttggtga atttagattg gagagaaaat ggttgatgt ggtgaggaac aggattgccc 780  
 aggacctctc cttacgccga ttcattggtc ctctaatact ggatatcaag agaaccaccg 840  
 gaaacaaacc caggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900  
 gattagccag ttttatcctg actattaagt ttgggataga aactatgtat cctgctcttg 960  
 gactgcatga atttgctggt gagttatcca cacttgagtc cttgatgaac ctttaccagc 1020  
 aaatggggga aactgcaccc tacatggtaa tcctggagaa ctcaattcag aacaagttca 1080  
 gtgcaggatc atacctctg ctctggagct atgccatggg agtaggagtg gaacttgaaa 1140  
 actccatggg aggtttgaac tttggccgat cttactttga tccagcatat tttagattag 1200  
 ggcaagagat ggtaaggagg tcagctggaa aggtcagttc cacattggca tctgaactcg 1260  
 gtatcactgc cgaggatgca aggcttgttt cagagattgc aatgcatact actgaggaca 1320  
 agatcagtag agcggttgga cccagacaag cccaagtatc atttctacac ggtgatcaaa 1380  
 gtgagaatga gctaccgaga ttggggggca aggaagatag gagggcctaaa cagagtcgag 1440  
 gagaagccag ggagagctac agagaaaccg ggcccagcag agcaagtgat gcgagagctg 1500  
 cccatcttcc aaccggcaca cccctagaca ttgacactgc aacggagtcc agccaagatc 1560  
 cgcaggacag tcgaaggcca gctgacgccc tgcttaggct gcaagccatg gcaggaatct 1620  
 cggaagaaca aggtcagac acggacaccc ctatagtgtg caatgacaga aatcttctag 1680  
 actaggtgag agaggccgag ggccagaaca acatccgcct accatccatc attgttataa 1740  
 aaaacttagg aaccaggtcc acacagccgc cagcccatca accatccact cccacgattg 1800  
 gagccaatgg cagaagagca ggcacgcat gtcaaaaacg gactggaatg catccgggct 1860  
 ctcaaggccg agcccatcgg ctactggcc atcgaggaag ctatggcagc atggtcagaa 1920  
 atatcagaca acccaggaca ggagcgagcc acctgcaggg aagagaaggc aggcagttcg 1980  
 ggtctcagca aacctgcct ctacgaatt ggatcaactg aaggcgggtg acctcgcatc 2040  
 cgcggtcagg gacctggaga gagcgatgac gacgctgaaa ctttggaat cccccaaga 2100  
 aatctccagg catcaagcac tgggttacag tggtattacg tttatgatca cagcggtgaa 2160  
 gcgggttaagg gaatccaaga tgctgactct atcatggttc aatcaggcct tgatgggtgat 2220  
 agcacctctc caggaggaga caatgaatct gaaaacagcg atgtggatat tggcgaacct 2280  
 gataccgagg gatatgctat cactgaccgg ggtctgctc ccatctctat ggggttcagg 2340  
 gcttctgatg ttgaaactgc agaaggagg gagatccacg agctcctgag actccaatcc 2400  
 agaggcaaca actttccgaa gcttgggaaa actctcaatg ttctccgcc cccggacccc 2460  
 ggtagggccca gcacttccgg gacacccatt aaaaaggcca cagacgcgag attagcctca 2520  
 tttggaacgg agatcgctc tttattgaca ggtggtgcaa cccaatgtgc tcgaaagtca 2580  
 cctcgggaac catcagggcc aggtgcacct gcggggaatg tccccgagtg tgtgagcaat 2640  
 gccgcactga tacaggagtg gacacccgaa tctggtacca caatctccc gagatcccag 2700  
 aataatgaag aagggggaga ctattatgat gatgagctgt tctctgatgt ccaagatatt 2760  
 aaaacagcct tggccaaaat acacgaggat aatcagaaga taatctccaa gctagaatca 2820  
 ctgctgttat tgaagggaga agttgagtca attaagaagc agatcaacag gcaaaatatc 2880  
 agcatatcca cctggaagg acacctctca agcatcatga tcgccattcc tggacttggg 2940  
 aaggatccca acgacccac tgcagatgtc gaaatcaatc ccgacttgaa acccatcata 3000  
 ggcagagatt caggccgagc actggccgaa gttctcaaga aaccggttg cagccgacaa 3060  
 ctccaaggaa tgacaaatgg acggaccagt tccagaggac agctgctgaa ggaatttcag 3120  
 ctaaagccga tcgggaaaaa gatgagctca gccgtcgggt ttgttcctga caccggccct 3180  
 gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240  
 cgttacctga tgactctct tgatgatatc aaaggagcca atgatcttgc caagttccac 3300



cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caaccccatg 3360  
 ccagtcgacc caactagtag aacctaaatc cattataaaa aacttaggag caaagtgtatt 3420  
 gcctcccaag gtccacaatg acagagacct acgacttcga caagtcggca tgggacatca 3480  
 aagggctgat cgctccgata caaccaccca cctacagtga tggcaggctg gtgcccagg 3540  
 tcagagtcac agatcctggg ctaggcgaca ggaaggatga atgctttatg tacatgtttc 3600  
 tgctgggggt tggtgaggac agcgattccc tagggcctcc aatcgggcga gcatttgggt 3660  
 tcctgccctt aggtgttggc agatccacag caaagcccga aaaactcctc aaagaggcca 3720  
 ctgagcttga catagtgtt agacgtacag cagggtctca tgaaaaactg gtgttctaca 3780  
 acaacacccc actaactctc ctcacacctt ggagaaaggc cctaacaaca gggagtgtct 3840  
 tcaacgcaaa ccaagtgtgc aatgcggtta atctgatacc gctcgatacc ccgcagaggt 3900  
 tccgtgttgt ttatatgagc atcacccgtc tttcggataa cgggtattac accgttccca 3960  
 gaagaatgct ggaattcaga tcggtcaatg cagtggcctt caacctgctg gtgacctta 4020  
 ggattgacaa ggcgataggc cctgggaaga tcatcgacaa tacagagcaa cttcctgagg 4080  
 caacatttat ggtccacatc gggaacttca ggagaaagaa gagtgaagtc tactctgccg 4140  
 attattgcaa aatgaaaatc gaaaagatgg gcctggtttt tgcacttggg gggatagggg 4200  
 gcaccagtct tcacattaga agcacaggca aaatgagcaa gactctccat gcacaactcg 4260  
 gggtcaagaa gaccttatgt taccgctga tggatatcaa tgaagacctt aatcgattac 4320  
 tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagttcctc 4380  
 aagaattccg catttacgac gacgtgatca taaatgatga ccaaggacta ttcaaagttc 4440  
 tgtagaccgt agtgcccagc aatgcccga aacgaccccc ctcacaatga cagccagaag 4500  
 gcccgacaaa aaaagcccc tccgaaagac tccacggacc aagcgagagg ccagccagca 4560  
 gccgacggca agcgcaaca ccaggcggcc ccagcacaga acagccctga cacaaggcca 4620  
 ccaccagcca cccaatctg catcctcctc gtgggacccc cgaggaccaa ccccaaggc 4680  
 tgccccgat ccaaaccacc aaccgcatcc ccaccacccc cgggaaagaa acccccagca 4740  
 attggaaggc ccctcccoct cttcctcaac acaagaactc cacaaccgaa ccgcacaagc 4800  
 gaccgagggtg acccaaccgc aggcattcga ctccctagac agatcctctc tccccggcaa 4860  
 actaaacaaa acttagggcc aaggaacata cacaccaac agaaccaga ccccggtcca 4920  
 cgggtgccgcg ccccaacccc ccgacaacca gagggagccc ccaaccaatc ccgcccgtc 4980  
 ccccggtgcc cacaggcagg gacaccaacc cccgaacaga ccagcaccc aaccatcgac 5040  
 aatccaagac gggggggccc ccccaaaaaa agggccccag gggccgacag ccagcaccgc 5100  
 gaggaagccc acccacccca cacacgacca cggcaaccaa accagaaccc agaccaccct 5160  
 gggccaccag ctcccagact cggccatcac cccgcagaaa ggaaaggcca caaccgcgc 5220  
 accccagccc cgatccggcg gggagccacc caaccgaa cagcacccaa gagcgatccc 5280  
 cgaaggaccc ccgaaccgca aaggacatca gtatccaca gcctctccaa gtccccgggt 5340  
 ctctcctct tctcgaagg accaaaagat caatccacca caccgacga cactcaactc 5400  
 cccaccccta aaggagacac cgggaatccc agaatacaga ctcatccaat gtccatcatg 5460  
 ggtctcaagg tgaacgtctc tgccatattc atggcagtag tgttaactct ccaaaccacc 5520  
 accggtcaaa tccattgggg caatctctct aagatagggg tggtaggaat aggaagtgc 5580  
 agctacaaag ttatgactcg ttccagccat caatcattag tcataaaatt aatgcccatt 5640  
 ataactctcc tcaataactg cacgagggtg gagattgcag aatacaggag actactgaga 5700  
 acagttttgg aaccaattag agatgcactt aatgcaatga ccagaatat aagaccggtt 5760  
 cagagtgtag cttcaagtag gagacacaag agatttgcgg gtagtagcct ggcagggtcg 5820  
 gccttaggcy ttgccacagc tgctcagata acagccggca ttgcacttca ccagtcctatg 5880  
 ctgaactctc aagccatcga caatctgaga gcgagcctgg aaactactaa tcaggcaatt 5940  
 gagacaatca gacaagcagg gcaggagatg atattggctg ttcagggtgt ccaagactac 6000  
 atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaatt cggccagaag 6060  
 ctccggctca aattgtctag atactatata gaaatcctgt cattatttgg cccagttta 6120  
 cgggacccca tatctgcgga gatattctatc caggctttga gctatgcgct tggaggagac 6180

atcaataagg tgtagaaaa gctcggatac agtggaggtg atttactggg catcttagag 6240  
 agcggaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtcctc 6300  
 agtatagcct atccgacgct gtccgagatt aagggggtga ttgtccaccg gctagagggg 6360  
 gtctcgtaca acataggctc tcaagagtgg tataccactg tgcccaagta tggtgcaacc 6420  
 caagggtacc ttatctcgaa ttttgatgag tcatcgtgta ctttcatgcc agaggggact 6480  
 gtgtgcagcc aaaatgcctt gtacccgatg agtcctctgc tccaagaatg cctccggggg 6540  
 tacaccaagt cctgtgctcg tacactcgta tccgggtctt ttgggaaccg gttcatttta 6600  
 tcacaaggga acctaatagc caattgtgca tcaatccttt gcaagtgtta cacaacagga 6660  
 acgatcatta atcaagaccc tgacaagatc ctaacatata ttgctgccga tctactgccg 6720  
 gtagtcgagg tgaacggcgt gaccatccaa gtcgggagca ggaggtatcc agacgctgtg 6780  
 tacttgacac gaattgacct cggctcctcc atatcattgg agaggttggg cgtagggaca 6840  
 aatctgggga atgcaattgc taagtggag gatgccaagg aattgttggg gtcacggac 6900  
 cagatattga ggagtatgaa aggtttatcg agcactagca tagtctacat cctgattgca 6960  
 gtgtgtcttg gaggtttgat agggatcccc gctttaatat gttgctgcag ggggctgtgt 7020  
 aacaaaaagg gagaacaagt tggtagtca agaccaggcc taaagcctga tcttacggga 7080  
 acatcaaaat cctatgtaag gtcgctctga tctctacaa ctcttgaaac acaaatgtcc 7140  
 cacaagtctc ctcttcgtca tcaagcaacc accgcaccca gcatcaagcc cacctgaaat 7200  
 tatctccggc ttccctctgg ccgaacaata tcggtagtta atcaaaactt aggggtgcaag 7260  
 atcatccaca atgtcaccac aacgagaccg gataaatgcc ttctacaaag ataaccacca 7320  
 tcccaaggga agtaggatag tcattaacag agaacatctt atgattgata gaccttatgt 7380  
 tttgctggct gttctgtttg tcatgtttct gagcttgatc ggggtgctag ccattgcagg 7440  
 cattagactt catcgggcag ccatctacac cgagagatc cataaaagcc tcagaccaa 7500  
 tctagatgta actaactcaa tcgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560  
 aatcatcggg gatgaagtgg gcctgaggac acctcagaga ttactgacc tagtgaatt 7620  
 aatctctgac aagattaaat tccttaatcc ggatagggag tacgacttca gagatctcac 7680  
 ttggtgtatc aaccgccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740  
 ggctgctgaa gagctcatga atgcattggg gaactcaact ctactggaga ccagaacaac 7800  
 caatcagttc ctagctgtct caaagggaat ctgctcaggg cccactacaa tcagaggtca 7860  
 attctcaaac atgtcgctgt ccctgttaga cttgtattta ggtcgagggt acaatgtgtc 7920  
 atctatagtc actatgacat cccagggaat gtatggggga acctacctag tggaaaagcc 7980  
 taatctgagc agcaaaaggc cagagttgtc acaactgagc atgtaccgag tgtttgaagt 8040  
 aggtgttatc agaaatccgg gtttgggggc tccggtgttc catatgacaa actatcttga 8100  
 gcaaccagtc agtaatgatc tcagcaactg tatggtggct ttgggggagc tcaactcgc 8160  
 agccctttgt cacggggaag attctatcac aattccctat cagggatcag ggaaagggtg 8220  
 cagcttccag ctcgtaagc taggtgtctg gaaatccca accgacatgc aatcctgggt 8280  
 ccccttatca acggatgatc cagtgataga caggctttac ctctcatctc acagaggtgt 8340  
 tatcgtgac aatcaagcaa aatgggctgt cccgacaaca cgaacagatg acaagttgag 8400  
 aatggagaca tgcttccaac aggcgtgtaa gggtaaaatc caagcactct gcgagaatcc 8460  
 cgagtgggca ccattgaagg ataacaggat tccttcatac ggggtcttgt ctgttgatct 8520  
 gagtctgaca gttgagctta aaatcaaaat tgcttcggga ttcgggccat tgatcacaca 8580  
 cggttcaggg atggacctat acaaatccaa ccacaacaat gtgtattggc tgactatccc 8640  
 gccaatgaag aacctagcct taggtgtaat caacacattg gagtggatac cgagattcaa 8700  
 ggtagtccc tacctcttca ctgtcccaat taagggaagca ggcaagact gccatgcccc 8760  
 aacataccta cctgcggagg tggatgggtg tgtaaaactc agttccaatc tgggtgattct 8820  
 acctgggtcaa gatctccaat atgttttggc aacctacgat acttccaggg ttgaacatgc 8880  
 tgtgggtttat tacgtttaca gcccaagccg ctcatcttct tacttttctc cttttagggt 8940  
 gcctataaag ggggtcccca tcgaattaca agtggaatgc ttcacatggg accaaaaact 9000  
 ctgggtgccgt cacttctgtg tgcttgccga ctcagaatct ggtggacata tctactcctc 9060

tgggatgggtg ggcattgggag tcagctgcac agtcacccgg gaagatggaa ccaatcgag 9120  
 atagggctgc tagtgaacca atcacatgat gtcacccaga catcaggcat acccactagt 9180  
 gtgaaataga catcagaatt aagaaaaacg taggggtccaa gtggttcccc gttatggact 9240  
 cgctatctgt caaccagatc ttataccctg aagttcacct agatagcccg atagttagca 9300  
 ataagatagt agccatcctg gagtatgtc gagtccctca cgcttacagc ctggaggacc 9360  
 ctacactgtg tcagaacatc aagcaccgcc taaaaaacgg attttccaac caaatgatta 9420  
 taaacaatgt ggaagttggg aatgtcatca agtccaagct taggagttat cgggccact 9480  
 ctcatattcc atatccaaat tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540  
 cgaggaagat ccgtgaactc ctcaaaaagg ggaattcgct gtactccaaa gtcagtata 9600  
 aggttttcca atgcttaagg gacactaact cacggcttgg cctaggctcc gaattgagg 9660  
 aggacatcaa ggagaaagtt attacttgg gagtttacct gcacagctcc cagtgtttg 9720  
 agccctttct gttttgggtt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780  
 ccatacttg ccataggagg agacacacac ctgtattctt cactgtagt tcagttgagt 9840  
 tgctaattct tcgtgacctt gttgtataa tcagtaaaga gtctcaacat gtatattacc 9900  
 tgacatttga actggttttg atgtattgt atgtcataga ggggaggtta atgacagaga 9960  
 ccgtatgac tattgatgct aggtatacag agcttctagg aagagtcaga tacatgtgga 10020  
 aactgataga tggtttcttc cctgcaactc ggaatccaac ttatcaaatt gtagccatgc 10080  
 tggagcctct ttcacttgct tacctgcagc tgagggatat aacagtagaa ctgagaggtg 10140  
 ctttctctaa ccactgcttt actgaaatac atgatgttct tgaccaaaac ggggtttctg 10200  
 atgaaggtag ttatcatgag ttaactgaag ctctagatta cattttcata actgatgaca 10260  
 tacatctgac aggggagatt ttctcatttt tcagaagttt cggccacccc agactgaag 10320  
 cagtaacggc tgctgaaaat gttaggaaat acatgaatca gcctaaagtc attgtgtatg 10380  
 agactctgat gaaaggatcat gccatatttt gtggaatcat aatcaacggc tatctgtaga 10440  
 ggcacggagg cagttggcca ccgctgacct tccccctgca tgctgcagac acaatccgga 10500  
 atgctcaagc ttcaggtgaa ggggttaacac atgagcagtg cgttgataac tggaaatctt 10560  
 ttgctggagt gaaatttggc tgctttatgc ctcttagcct ggatagtgat ctgacaatgt 10620  
 acctaaagga caaggcactt gctgctctcc aaagggaatg ggattcagtt taccgaaag 10680  
 agttcctgct ttacgacctt cccaaggga cgggtcacg gaggtctgta gatgttttcc 10740  
 ttaatgattc gagctttgac ccatatgatg tgataatgta tgttgtaagt ggagcttacc 10800  
 tccatgacct tgagttcaac ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860  
 gtagactttt tgctaaaatg acttacaaaa tgagggcatg ccaagtgatt gctgaaaatc 10920  
 taatctcaaa cgggattggc aaatatttta aggacaatgg gatggccaag gatgagcacg 10980  
 atttgactaa ggcaactcac actctagctg tctcaggagt ccccaaagat ctcaaagaaa 11040  
 gtcacagggg ggggccagtc ttaaaaacct actcccgaag ccaggtccac acaagtacca 11100  
 ggaacgtgag agcagcaaaa gggtttatag ggttccctca agtaattcgg caggaccaag 11160  
 acactgatca tccggagaat atggaagctt acgagacagt cagtgcattt atcacgactg 11220  
 atctcaagaa gtactgcctt aattggagat atgagaccat cagcttggtt gcacagaggc 11280  
 taaatgagat ttacggattg cctcattttt tccagtggct gcataagagg cttgagacct 11340  
 ctgtcctgta tgtaagtgc cctcattgcc ccccgacct tgacgccc atcccgttat 11400  
 ataaagtccc caatgatcaa atcttcatta agtacctat gggaggtata gaagggtatt 11460  
 gtcagaagct gtggaccatc agcaccatc cctatctata cctggctgct tatgagagcg 11520  
 gagtaaggat tgcttcgtta gtgcaagggg acaatcagac catagccgta acaaaaagg 11580  
 taccagcac atggccctac aaccttaaga aacgggaagc tgctagagta actagagatt 11640  
 actttgtaat tcttaggcaa aggctacatg atattggcca tcacctcaag gcaaatgaga 11700  
 caattgtttc atcacatttt tttgtctatt caaaaggaat atattatgat gggctacttg 11760  
 tgtcccaatc actcaagagc atcgcaagat gtgtattctg gtcagagact atagttgatg 11820  
 aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagaggtt 11880  
 atgaccgtta ccttgcata tccctgaagc tcctaaaagt gatacagcaa attctgatct 11940

```

ctcttggcctt cacaatcaat tcaaccatga cccgggatgt agtcataccc ctccctcacia 12000
acaacgacct cttaataagg atggcactgt tgcccgcctc tattgggggg atgaattatc 12060
tgaatatgag caggctgttt gtcagaaaca tcggtgatcc agtaacatca tcaattgctg 12120
atctcaagag aatgattctc gcctcactaa tgctgaaga gacctccat caagtaatga 12180
cacaacaacc gggggactct tcattcctag actgggctag cgaccttac tcagcaaadc 12240
ttgtatgtgt ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctga 12300
tccatagtcc aaacccaatg ttaaaaggat tattccatga tgacagtaaa gaagaggacg 12360
agggactggc ggcattcctc atggacaggc atattatagt acctagggca gctcatgaaa 12420
tcctggatca tagtgtcaca ggggcaagag agtctattgc aggcattgctg gataccacia 12480
aaggcttgat tcgagccagc atgaggaagg ggggggttaac ctctcgagtg ataaccagat 12540
tgtccaatta tgactatgaa caattcagag cagggatggt gctattgaca ggaagaaaga 12600
gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggcgagagct ctaagaagcc 12660
atatgtgggc gaggctagct cgaggacggc ctatttacgg ccttgaggtc cctgatgtac 12720
tagaatctat gcgaggccac cttattcggc gtcattgagac atgtgtcatc tgcgagtgtg 12780
gatcagtcaa ctacggatgg ttttttgtcc cctcgggttg ccaactggat gatattgaca 12840
aggaaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900
tgaagcttgc ctctgtaaga gcccgaagtc gatccttgcg atctgctgtt agaatagcaa 12960
cagtgtactc atgggcttac ggtgatgatg atagctcttg gaacgaagcc tgggtgttg 13020
ctaggcaaaag ggccaatgtg agcctggagg agctaagggt gatcactccc atctcaactt 13080
cgactaattt agcgcatagg ttgagggatc gtacactca agtgaaatac tcaggatcat 13140
cccttgtccg agtggcgagg tataccacia tctccaacga caatctctca tttgtcatat 13200
cagataagaa ggttgatact aactttatat accaacaagg aatgtctcta gggttgggtg 13260
ttttagaaac attgtttcga ctcgagaaag ataccggatc atctaacacg gtattacatc 13320
ttcacgtcga aacagattgt tgcgtgatcc cgatgataga tcatcccagg ataccagct 13380
cccgaagct agagctgagg gcagagctat gtaccaaccc attgatatat gataatgcac 13440
ctttaattga cagagatgca acaaggctat acaccagag ccataggagg caccttgttg 13500
aatttgttac atggtccaca ccccaactat atcacatttt agctaagtc acagcactat 13560
ctatgattga cctggttaaca aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620
taggggatga cgatatcaat agtttcataa ctgagtttct gctcatagag ccaagattat 13680
tcactatcta cttgggccag tgtgcggcca tcaattgggc atttgatgta cattatcata 13740
gaccatcagg gaaatatcag atgggtgagc tgttgtcatc gttcctttct agaatagaca 13800
aaggagtgtt taagggtgct gtcaatgtc taagccacc aaagatctac aagaaattct 13860
ggcattgtgg tattatagag cctatccatg gtccttctct tgatgctcaa aacttgaca 13920
caactgtgtg caacatggtt tacacatgct atatgacct cctcgacctg ttgttgaatg 13980
aagagttaga agagtccaca tttctcttgt gtgaaagcga cgaggatgta gtaccggaca 14040
gattcgacaa catccaggca aaacacttat gtgttctggc agatttgtac tgtcaaccag 14100
ggacctgcc accaattcga ggtctaagac cggtagagaa atgtgcagtt ctaaccgacc 14160
atatcaaggc agaggctatg ttatctccag caggatcttc gtggaacata aatccaatta 14220
ttgtagacca ttactcatgc tctctgactt atctccggcg aggatecatc aaacagataa 14280
gattgagagt tgatccagga ttcattttcg acgcccctgc tgaggtaaatt gtcagtcagc 14340
caaagatcgg cagcaacaac atctcaaata tgagcatcaa ggctttcaga cccccacacg 14400
atgatgttgc aaaattgtc aaagatatca acacaagcaa gcacaatctt cccatttcag 14460
ggggcaatct cgccaattat gaaatccatg ctttccgcag aatcgggttg aactcatctg 14520
cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccaggggagg 14580
acggcttggt cttgggtgag ggatcgggtt ctatgttgat cacttataaa gagatactta 14640
aactaaacia gtgcttctat aatagtgggg tttccgcaa ttctagatct ggtcaaagg 14700
aattagcacc ctatccctcc gaagtggcc ttgtcgaaca cagaatggga gtaggtaata 14760
ttgtcaaagt gctctttaac gggaggcccg aagtcacgtg ggtaggcagt gtagattgct 14820

```

```

tcaatttcat agttagtaat atccctacct ctagtggtggg gtttatccat tcagatatag 14880
agaccttgcc tgacaaagat actatagaga agctagagga attggcagcc atcttatcga 14940
tggctctgct cctgggcaaa ataggatcaa tactggtgat taagcttatg cctttcagcg 15000
gggattttgt tcagggattt ataagttatg tagggctctca ttatagagaa gtgaaccttg 15060
tataccctag atacagcaac ttcattctcta ctgaatctta tttgggttatg acagatctca 15120
aggctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcatctgtga 15180
ggacttcacc tggacttata ggtcacatcc tatccattaa gcaactaagc tgcatacaag 15240
caattgtggg agacgcagtt agtagagggtg atatcaatcc tactctgaaa aaacttacac 15300
ctatagagca ggtgctgac aattgcgggt tggcaattaa cggacctag ctgtgcaaag 15360
aattgatcca ccatgatgtt gcctcagggc aagatggatt gcttaattct atactcatcc 15420
tctacaggga gttggcaaga ttcaaagaca accaaagaag tcaacaaggg atgttccacg 15480
cttacccegt attggtaagt agcaggcaac gagaacttat atctaggatc acccgcaaat 15540
tctgggggca cattcttctt tactccggga acaaaaagtt gataaataag tttatccaga 15600
atctcaagtc cggctatctg atactagact tacaccagaa tatcttcgtt aagaatctat 15660
ccaagtcaga gaaacagatt attatgacgg ggggtttgaa acgtgagtggt gtttttaagg 15720
taacagtcaa ggagaccaa gaatggtata agttagtcgg atacagtgcc ctgattaagg 15780
actaattggt tgaactccgg aaccctaata ctgccctagg tggtaggca ttatttgcaa 15840
tatattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

```

&lt;210&gt; 7

&lt;211&gt; 15894

&lt;212&gt; DNA

&lt;213&gt; Measles virus

&lt;400&gt; 7

```

accaaacaaa gttgggtaag gatagttcaa tcaatgatca ttttctagt cacttaggat 60
tcaagatcct attatcaggg acaagagcag gattaaggat atccgagatg gccacacttt 120
taaggagctt agcattgttc aaaagaaaca aggacaaacc acccattaca tcaggatccg 180
gtggagccat cagaggaatc aaacacatta ttatagtacc aatccctgga gattcctcaa 240
ttaccactcg atccagactt ctggaccggt tggtcagggt aattggaaac ccgatgtga 300
gcgggcccaa actaacaggg gcactaatag gtatattatc cttatttgtg gagtctccag 360
gtcaattgat tcagaggatc accgatgacc ctgacgttag cataaggctg ttagagggtg 420
tccagagtga ccagtcacaa tctggcctta ccttcgcac aagaggtagc aacatggagg 480
atgaggcgga ccaatacttt tcacatgatg atccaattag tagtgatcaa tccagggttcg 540
gatggttcga gaacaaggaa atctcagata ttgaagtgca agaccctgag ggattcaaca 600
tgattctggg taccatccta gctcaaattt gggctctgct cgcaaaggcg gttacggccc 660
cagacacggc agctgattcg gagctaagaa ggtggataaa gtacaccaa caaagaaggg 720
tagttggtga atttagattg gagagaaaat ggttggtatg ggtgaggaa aggattgccg 780
aggacctctc cttacgccga ttcattggtc ctctaatact ggatatcaag agaacacccg 840
gaaacaaacc caggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900
gattagccag ttttatcctg actattaagt ttgggtaga aactatgtat cctgctcttg 960
gactgcatga atttgctggt gagttatcca cacttgagtc cttgatgaac cttaccagc 1020
aaatggggga aactgcaccc tacatggtaa tcttgagaa ctcaattcag aacaagttca 1080
gtgcaggatc ataccctctg ctctggagct atgccatggg agtaggagtg gaacttgaaa 1140
actccatggg aggtttgaac tttggccgat cttactttga tccagcatat ttagattag 1200
ggcaagagat ggtaaggagg tcagctggaa aggtcagttc cacattggca tctgaactcg 1260
gtatcactgc cgaggatgca aggcttggtt cagagattgc aatgcatact actgaggaca 1320
agatcagtag agcgggttga cccagacaag cccaagtatc atttctacac ggtgatcaaa 1380

```

gtgagaatga gctaccgaga ttggggggca aggaagatag gaggggtcaaa cagagtcgag 1440  
 gagaagccag ggagagctac agagaaaccg ggcccagcag agcaagtgat gcgagagctg 1500  
 cccatcttcc aaccggcaca cccctagaca ttgacactgc atcggagtcg agccaagatc 1560  
 cgcaggacag tcgaagggtca gctgacgccc tgcttaggct gcaagccatg gcaggaatct 1620  
 cggaagaaca aggtcagac acggacaccc ctatagtgtg caatgacaga aatcttctag 1680  
 actaggtgcg agaggccgag ggccagaaca acatccgcct accctccatc attgttataa 1740  
 aaaacttagg aaccagggtcc acacagccgc cagcccatca accatccact cccacgattg 1800  
 gagccgatgg cagaagagca ggcacgcat gtcaaaaacg gactggaatg catccgggct 1860  
 ctcaaggccg agcccatcgg ctactggcc atcgaggaag ctatggcagc atggtcagaa 1920  
 atatcagaca acccaggaca ggagcgagcc acctgcaggg aagagaaggc aggcagttcg 1980  
 ggtctcagca aaccatgcct ctacgaatt ggatcaactg aaggcgggtg acctcgcatc 2040  
 cgcggtcagg gacctggaga gagcgatgac gacgctgaaa ctttgggaat cccccaaga 2100  
 aatctccagg catcaagcac tgggttacag tggtattatg tttatgatca cagcggtgaa 2160  
 gcggttaagg gaatccaaga tgctgactct atcatggttc aatcaggcct tgatgggatg 2220  
 agcaccctct caggaggaga caatgaatct gaaaacagcg atgtggatat tggcgaacct 2280  
 gataccgagg gatatgctat cactgaccgg ggatctgctc ccatctctat ggggttcagg 2340  
 gcttctgatg ttgaaactgc agaaggaggg gagatccacg agctcctgag actccaatcc 2400  
 agaggcaaca actttccgaa gcttgggaaa actctcaatg ttcctccgcc tccggacccc 2460  
 ggtagggcca gcacttccgg gacacccatt aaaaaggcca cagacgcgag attagcctca 2520  
 tttggaacgg agatcgcgtc tttattgaca ggtggtgcaa ccaatgtgc tcgaaagtca 2580  
 ccctcggaac catcagggcc aggtgcacct gcggggaatg tccccgagtg tgtgagcaat 2640  
 gccgcactga tacaggagtg gacacccgaa tctggtacca caatctcccc gagatcccag 2700  
 aataatgaag aagggggaga ctattatgat gatgagctgt tctctgatgt ccaagatatt 2760  
 aaaacagcct tggccaaaat acacgaggat aatcagaaga taatctccaa gctagaatca 2820  
 ctgctgttat tgaagggaga agttgagtca attaagaagc agatcaacag gcaaaatata 2880  
 agcatatcca ccctggaagg acacctctca agcatcatga tcgccattcc tggacttggg 2940  
 aaggatccca acgacccccc tgcatatgtc gaaatcaatc ccgacttgaa acccatcata 3000  
 ggcagagatt caggccgagc actggccgaa gttctcaaga aaccggttg cagccgacaa 3060  
 ctccaaggaa tgacaaatgg acggaccagt tccagaggac agctgctgaa ggaatttcag 3120  
 ctaaagccga tcgggaaaaa gatgagctca gccgtcgggt ttgttcctga caccggccct 3180  
 gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240  
 cgttacctga tgactctcct tgatgatata aaaggagcca atgatcttgc caagttccac 3300  
 cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caaccccatg 3360  
 ccagtcgacc caactagtac aacctaaatc cattataaaa aacttaggag caaagtgatt 3420  
 gcctcccaag ttccacaatg acagagatct acgacttcga caagtcggca tgggacatca 3480  
 aagggttgat cgctccgata caaccaccca cctacagtga tggcaggctg gtgccccagg 3540  
 tcagagtcac agatcctggg ctaggcgaca ggaaggatga atgctttatg tacatgtttc 3600  
 tgctgggggt tggtgaggac agcgatcccc tagggcctcc aatcgggcca gcatttgggt 3660  
 ccctgccttt aggtgttggc aaatccacag caaagcccga aaaactcctc aaagaggcca 3720  
 ctgagcttga catagtgttt agacgtacag cagggtctca tgaaaaactg gtgttctaca 3780  
 acaacacccc actaactctc ctcacacctt ggagaaaggc cctaacaaca gggagtgtct 3840  
 tcaacgcaaa ccaagtgtgc agtgcggtta atctgatacc gctcgatacc ccgcagaggt 3900  
 tccgtgttgt ttatatgagc atcacccgtc tttcggataa cgggtattac accgttccca 3960  
 gaagaatgct ggaattcaga tcggtcaatg cagtggcctt caacctgctg gtgacctta 4020  
 ggattgacaa ggcgataggc cctgggaaga tcatcgacaa tacagagcaa ctctctgagg 4080  
 caacatttat ggtccacatc gggaaacttca ggagaaagaa gagtgaagtc tactctgccg 4140  
 attattgcaa aatgaaaatc gaaaagatgg gcctgggttt tgcaattggg gggatagggg 4200  
 gcaccagtct tcacattaga agcacaggca aaatgagcaa gactctccat gcacaactcg 4260

ggttcaagaa gaccttatgt taccgctga tagatatcaa tgaagacctt aatcgattac 4320  
 tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagttcctc 4380  
 aagaattccg catttacgac gacgtgatca taaatgatga ccaaggacta ttcaaaagttc 4440  
 tgtagaccgt agtgcccagc aatgcccga aacgaccccc ctcacaatga cagccagaag 4500  
 gcccggacaa aaaagccccc tccgaaagac tccacggacc aagcgagagg ccagccagca 4560  
 gccgacggca agcgcgaaca ccaggcggcc ccagcacaga acagccctga tacaaggcca 4620  
 ccaccagcca ccccaatctg catcctctc gtgggacccc cgaggaccaa ccccaaggc 4680  
 tgccccgat ccaaaccacc aaccgcatcc ccaccacccc cgggaaagaa accccagca 4740  
 attggaaggc cctccccct cttcctcaac acaagaactc cacaaccgaa cgcacaagc 4800  
 gaccgaggtg acccaaccgc aggcattcga ctccctagac agatcctctc tccccggca 4860  
 actaaacaaa acttagggcc aaggaaacata cacacccaac agaaccaga ccccgccca 4920  
 cggcgccg cccccaaccc ccgacaacca gagggagccc ccaaccaatc cgcgcgctc 4980  
 ccccggtgcc cacaggcagg gacaccaacc ccgaacaga ccagcaccc aaccatcgac 5040  
 aatccaagac gggggggccc ccccaaaaaa agggcccccag gggccgacag ccagcacgc 5100  
 gaggaagccc acccacccca cacacgacca cggcaaccaa accagaaccc agaccacct 5160  
 gggccaccag ctccagact cggccatcac cccgcagaaa ggaaaggcca caaccgcgc 5220  
 accccagccc cgatccggc gggagccacc caaccgaac cagcaccaa gagcgatccc 5280  
 cgaaggaccc ccgaaccgca aaggacatca gtatcccaca gcctctccaa gtccccggt 5340  
 ctctccct tctcgaagg accaaaagat caatccacca ccccgacga cactcaactc 5400  
 cccacccta aaggagacac cgggaatccc agaatacaga ctcatccaat gtccatcatg 5460  
 ggtctcaagg tgaacgtctc tgccatattc atggcagtag tgtaactct ccaaaccacc 5520  
 accggtcaaa tccattgggg caatctctct aagatagggg tggtaggaat aggaagtgc 5580  
 agctacaaag ttatgactcg tccagccat caatcattag tcataaaatt aatgccaat 5640  
 ataactctcc tcaataactg cacgagggtg gagattgcag aatacaggag actactgaga 5700  
 acagttttg aaccaattag agatgcactt aatgcaatga ccagaatat aagaccggt 5760  
 cagagtgtag cttaagtag gagacacaag agatttgagg gagtagtctt ggcaggtgcg 5820  
 gccctaggcg ttgccacagc tgctcagata acagccggca ttgcacttca ccagtcctatg 5880  
 ctgaactctc aagccatcga caatctgaga gcgagcctgg aaactactaa tcaggcaatt 5940  
 gaggcaatca gacaagcagg gcaggagatg atattggctg ttcagggtgt ccaagactac 6000  
 atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaat cggccagaag 6060  
 ctcggtctca aattgctcag atactataca gaaatcctgt cattatgttg cccagctta 6120  
 cgggacccca tatctgcgga gatattctatc caggctttga gctatgcgtc tggaggagac 6180  
 atcaataagg tgtagaaaa gctcggatag agtgagggtg atttactggg catcttagag 6240  
 agcagaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtctc 6300  
 agtatagcct atccgacgct gtccgagatt aagggggtga ttgtccaccg gctagagggg 6360  
 gtctcgtaca acataggctc tcaagagtgg tataccactg tgcccaagta tgttgcaacc 6420  
 caagggtagc ttatctcgaa ttttgatgag tcatcgtgta ctttcatgcc agaggggact 6480  
 gtgtgcagcc aaaatgcctt gtacccgatg agtcctctgc tccaagaatg cctccggggg 6540  
 tccaccaagt cctgtgctcg tacactcgta tccgggtctt ttgggaaccg gttcatttta 6600  
 tcacaaggga acctaatagc caattgtgca tcaatccttt gcaagtgtta cacaacagga 6660  
 acgatcatta atcaagaccc tgacaagatc ctaacataca ttgctgccga tcaactgccg 6720  
 gtagtcgagg tgaacggcgt gaccatccaa gtcgggagca ggaggtatcc agatgctgtg 6780  
 tacttgaca gaattgacct cggctctccc atatcattgg agaggttga cgtagggaca 6840  
 aatctgggga atgcaattgc taagttggag gatgccaagg aattgttga gtcacggac 6900  
 cagatattga ggagtatgaa aggtttatcg agcactagca tagtctacat cctgattgca 6960  
 gtgtgtcttg gagggttgat agggatcccc gctttaatat gttgctgcag gggcggtgt 7020  
 aacaaaaagg gagaacaagt tggatgtca agaccaggcc taaagcctga tcttacggga 7080  
 acatcaaaat cctatgtaag gtcgctctga tcctctacaa ctcttgaaac acaaatgtcc 7140

```

cacaagtctc ctcttcgtca tcaagcaacc accgcaccca gcatcaagcc cacctgaaat 7200
tatctccggc ttccctctgg ccgaacaata tcggtagtta attaaaactt aggggtgcaag 7260
atcatccaca atgtcaccac aacgagaccg gataaatgcc ttctacaaag ataaccacca 7320
tcccaaggga agtaggatag tcattaacag agaacatctt atgattgata gaccttatgt 7380
tttgctggct gttctgtttg tcatgtttct gagcttgatc gggttgctag ccattgcagg 7440
cattagactt catcgggcag ccatctacac cgcagagatc cataaaagcc tcagcaccaa 7500
tctagatgta actaactcaa tcgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560
aatcatcggc gatgaagtgg gcctgaggac acctcagaga ttactgacc tagtgaaatt 7620
catctctgac aagattaaat tccttaatcc ggatagggag tacgacttca gagatctcac 7680
ttggtgtatc aaccggccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740
ggctgctgaa gagctcatga atgcattggc gaactcaact ctactggaga ccagaacaac 7800
caatcagttc ctagctgtct caaagggaat ctgctcaggg ccactacaa tcagagggtca 7860
attctcaaac atgtcgctgt ccctgttaga ctgtatttta ggtcgagggt acaatgtgtc 7920
atctatagtc actatgacat ccagggaat gtatggggga acttacctag tggaaaagcc 7980
taatctgagc agcaaaaggt cagagttgtc acaactgagc atgtaccgag tgtttgaagt 8040
aggtgttatc agaaatccgg gtttgggggc tccggtgttc catatgacaa actatcttga 8100
gcaaccagcc agtaatgac tcagcaactg tatgggtggc ttgggggagc tcaaactcgc 8160
agccctttgt cagggggaag attctatcac aattccctat cagggatcag ggaaagggtg 8220
cagcttccag ctctgcaagc taggtgtctg gaaatcccca accgacatgc aatcctgggt 8280
ccccttatca acgatgac cagtgataga caggctttac ctctcatctc acagagggtg 8340
tatcgctgac aatcaagcaa aatgggctgt cccgacaaca cgaacagatg acaagttgctg 8400
aatggagaca tgcttccaac aggcgtgtaa gggtaaaatc caagcactct gcgagaatcc 8460
cgagtgggca ccattgaagg ataacaggat tccttcatac ggggtcttgt ctgttgatct 8520
gagtctgaca gttgagctta aaatcaaaat tgcttcggga ttccgggccat tgatcacaca 8580
cggttcaggg atggacctat acaaatccaa ccacaacaat gtgtattggc tgactatccc 8640
gccaatgaag aacctagcct taggtgtaat caacacattg gagtggatac cgagattcaa 8700
ggttagtccc tacctcttca atgtcccaat taagggaagc ggccaagact gccatgcccc 8760
aacataccta cctgcggagg tggatggtga tgtcaaactc agttccaatc tgggtgattct 8820
acctggtcaa gatctccaat atgttttggc aacctacgat acttcagggt ttgaacatgc 8880
tgtggtttat tacgtttaca gccaggccg ctcatcttct tacttttctc cttttagggt 8940
gcctataaag ggggtcccca tcgaattaca agtggaatgc ttcacatggg accaaaaact 9000
ctggtgccgt cacttctgtg tgcttgcgga ctcagaatct ggtggacata tcactcactc 9060
tgggatgggt ggcattggag tcagctgcac agtcacccg gaagatggaa ccaatcgag 9120
atagggctgc tagtgaacca atctcatgat gtcaccaga catcaggcat acccactagt 9180
gtgaaataga catcagaatt aagaaaaacg taggggtcaa gtggttcccc gttatggact 9240
cgctatctgt caaccagatc ttataacctg aagttcacct agatagcccg atagttacca 9300
ataagatagt agccatcctg gagtatgtc gagtccctca cgcttacagc ctggaggacc 9360
ctacactgtg tcagaacatc aagcaccgcc taaaaaacgg attttccaac caaatgatta 9420
taaacaatgt ggaagtggg aatgtcatca agtccaagct taggagttat ccggccact 9480
ctcatattcc atatccaaat tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540
cgaggaagat ccgtgaactc ctcaaaaagg ggaattcgct gtactccaaa gtcagtga 9600
aggttttcca atgcttaagg gacactaact cacggcttgg cctaggctcc gaattgagg 9660
aggacatcaa ggagaaagt attaacttgg gaggttacat gcacagctcc cagtgggtt 9720
agccctttct gttttgggtt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780
cccatacttg ccataggagg agacacacac ctgtattctt cactggtagt tcagttgagt 9840
tgctaacttc tcgtgacctt gttgtataaa tcagtaaaga gtctcaacat gtatattacc 9900
tgacatttga actgggtttg atgtattgtg atgtcataga ggggagggtt atgacagaga 9960
ccgctatgac tattgatgct aggtatacag agcttctagg aagagtcaga tacatgtgga 10020

```



aactgataga tgggtttcttc cctgcactcg ggaatccaac ttatcaaatt gtagccatgc 10080  
tggagcctct ttcacttgct tacctgcagc tgagggatat aacagtagaa ctacagagg 10140  
ctttccttaa ccactgcttt actgaaatac atgatgttct tgaccaaaac ggggtttctg 10200  
atgaaggtac ttatcatgag ttaattgaag ctctagatta cattttcata actgatgaca 10260  
tacatctgac aggggagatt ttctcatttt tcagaagttt cggccacccc agacttgaag 10320  
cagtaacggc tgctgaaaat gttaggaaat acatgaatca gcctaaagtc attgtgtatg 10380  
agactctgat gaaagggtcat gccatatatt gtggaatcat aatcaacggc tatcgtgaca 10440  
ggcacggagg cagttggcca ccgctgaccc tccccctgca tgctgcagac acaatccgga 10500  
atgctcaagc ttcagggtgaa ggggttaacac atgagcagtg cgttgataac tggaaatctt 10560  
ttgctggagt gaaatttggc tgctttatgc ctcttagcct ggatagtgat ctgacaatgt 10620  
acctaaagga caaggcactt gctgctctcc aaagggaatg ggattcagtt taccgaaag 10680  
agttcctgcg ttacgacctt cccaaggga cgggtcacg gaggttgta gatgttttcc 10740  
ttaatgatgc gagctttgac ccatatgatg tgataatgta tgttgtaagt ggagcttacc 10800  
tccatgaccc tgagttcaac ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860  
gtagactttt tgctaaaatg acttacaaaa tgagggcatg ccaagtgtt gctgaaaatc 10920  
taatctcaaa cgggattggc aaatatattt aggacaatgg gatggccaag gatgagcacg 10980  
atgtgactaa ggcaactcac actctagctg tctcaggagt ccccaaagat ctcaaagaaa 11040  
gtcacagggg ggggccagtc ttaaaaacct actcccgaag cccagtccac acaagtacca 11100  
ggaacgtgag agcagcaaaa ggggtttatag ggttccctca agtaattcgg caggaccaag 11160  
acactgatca tccggagaat atggaagctt acgagacagt cagtgcattt atcacgactg 11220  
atctcaagaa gtactgcctt aattggagat atgagaccat cagcttgttt gcacagaggc 11280  
taaataagat ttacggattg ccctcatttt tccagtggct gcataagagg cttgagacct 11340  
ctgtcctgta tgtaagtgac cctcattgcc ccccgcact tgacgccc atcccgttat 11400  
ataaagtccc caatgatcaa atcttcatta agtaccctat gggagggtata gaagggtatt 11460  
gtcagaagct gtggaccatc agcaccattc cctatctata cctggctgct tatgagagcg 11520  
gagtaaggat tgcttcgtta gtgcaagggg acaatcagac catagccgta acaaaaaggg 11580  
taccagcac atggccctac aaccttaaga aacgggaagc tgctagagta actagagatt 11640  
actttgtaat tcttaggcaa aggtacatg atattggcca tcacctcaag gcaaatgaga 11700  
caattgtttc atcacatttt tttgtctatt caaaaggaa atattatgat gggctacttg 11760  
tgtcccaatc actcaagagc atcgcaagat gtgtattctg gtcagagact atagttgatg 11820  
aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagagggt 11880  
atgaccgtta ccttgcatat tccctgaacg tcctaaaagt gatacagcaa attctgatct 11940  
ctcttggtt cacaatcaat tcaaccatga cccgggatgt agtcataccc ctccctacaa 12000  
acaacgacct cttaataagg atggcactgt tgcccgtcc tattggggg atgaattatc 12060  
tgaatatgag caggctgttt gtcagaaaca tcggtgatcc agtaacatca tcaattgctg 12120  
atctcaagag aatgattctc gcctcactaa tgctgaaga gacctccat caagtaatga 12180  
cacaacaacc gggggactct tcatcctag actgggctag cgaccttac tcagcaaata 12240  
ttgtatgtgt ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctga 12300  
tccatagtcc aaacccaatg ttaaaaggat tattccatga tgacagtaaa gaagaggacg 12360  
agggactggc ggcatctctc atggacaggc atattatagt acctagggca gctcatgaaa 12420  
tcctggatca tagtgtcaca ggggcaagag agtctattgc aggcattgctg gataccacaa 12480  
aaggcctgat tcgagccagc atgaggaagg gggggttaac ctctcgagtg ataaccagat 12540  
tgtccaatta tgactatgaa caattcagag cagggttggt gctattgaca ggaagaaaga 12600  
gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggcgagagct ctaagaagcc 12660  
atatgtgggc gaggctagct cgaggacggc ctatttacgg ccttgaggtc cctgatgtac 12720  
tagaatctat gcgaggccac cttattcggc gtcagagac atgtgtcatc tgcagtggtg 12780  
gatcagtc aa ctacggatgg tttttgtcc cctcgggttg ccaactggat gatattgaca 12840  
aggaaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900

tgaagcttgc cttcgttaaga gcccgaagtc gatccttgcg atctgctggt agaataagcaa 12960  
 cagtgtactc atgggcttac ggtgatgatg atagctcttg gaacgaagcc tgggtgttg 13020  
 ctaggcaaaag ggccaatgtg agcctggagg agctaagggt gatcactccc atctcaactt 13080  
 cgactaattt agcgcatagg ttgagggatc gtagcactca agtgaaatac tcagggtacat 13140  
 cccttgctcg agtggcgagg tataccacaa tctccaacga caatctctca tttgtcatat 13200  
 cagataagaa ggttgatact aactttatat accaacaagg aatgcttcta ggggtgggtg 13260  
 ttttagaaac attgtttcga ctcgagaaag ataccggatc atctaacacg gtattacatc 13320  
 ttcacgtcga aacagattgt tgcgtgatcc cgatgataga tcatcccagg ataccagct 13380  
 cccgcaagct agagctgagg gcagagctat gtaccaaccc attgatatat gataatgcac 13440  
 ctttaattga cagagatata acaaggctat acaccagag ccataggagg caccttggtg 13500  
 aatttggttac atggtccaca cccaactat atcacatttt agctaagtcc acagcactat 13560  
 ctatgattga cctggaataa aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620  
 taggggatga cgatatcaat agtttcataa ctgagtttct gctcatagag ccaagattat 13680  
 tcactatcta cttgggccag tgtgcggcca tcaattgggc atttgatgta cattatcata 13740  
 gaccatcagg gaaatatcag atgggtgagc tgtgtcatc gttcctttct agaattgagca 13800  
 aaggagtgtt taagggtgct gtcaatgctc taagccaccc aaagatctac aagaattct 13860  
 ggcattgttg tattatagag cctatccatg gtcttctact tgatgctcaa aacttgcaca 13920  
 caactgtgtg caacatgggt tacacatgct atatgacctt cctcgacctg ttgttgaatg 13980  
 aagagttaga agagttcaca tttctcttgt gtgaaagcga cgaggatgta gtaccggaca 14040  
 gattcgacaa catccaggca aaacacttat gtgttctggc agatttgtac tgtcaaccag 14100  
 ggacctgccc accaattcga ggtctaagac cggtagagaa atgtgcagtt ctaaccgacc 14160  
 atatcaaggc agaggctagg ttatctccag caggatcttc gtggaacata aatccaatta 14220  
 ttgtagacca ttactcatgc tctctgactt atctccggcg aggatcgatc aaacagataa 14280  
 gattgagagt tgatccagga ttcattttcg acgcccctcg tgaggtaaatt gtcagtcagc 14340  
 caaagatcgg cagcaacaac atctcaaata tgagcatcaa ggctttcaga cccccacacg 14400  
 atgatgttgc aaaattgctc aaagatatca acacaagcaa gcacaatctt cccatttcag 14460  
 ggggcaatct cgccaattat gaaatccatg ctttcccgag aatcgggttg aactcatctg 14520  
 cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccaggggagg 14580  
 acggcttgtt cttgggtgag ggatcgggtt ctatgttgat cacttataag gagatactta 14640  
 aactaaacaa gtgcttctat aatagtgggg tttccgcaa ttctagatct ggtcaaaggg 14700  
 aattagcacc ctatccctcc gaagtgggcc ttgtcgaaca cagaatggga gtaggtaata 14760  
 ttgtcaaagt gctctttaac gggaggcccg aagtacagtg ggtaggcagt gtagattgct 14820  
 tcaatttcat agttagtaat atccctacct ctagtgtggg gtttatccat tcagatatag 14880  
 agaccttgcc taacaaagat actatagaga agctagagga attggcagcc atcttatcga 14940  
 tggctctgct cctgggcaaa ataggatcaa tactggtgat taagcttatg cctttcagcg 15000  
 gggattttgt tcagggattt ataagttatg tagggtocca ttatagagaa gtgaaccttg 15060  
 tataccctag atacagcaac ttcatatcta ctgaatctta tttggttatg acagatctca 15120  
 aggctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcatctgtga 15180  
 ggacttcacc tggacttata ggtcacatcc tatccattaa gcaactaagc tgcatacaag 15240  
 caattgtggg agacgcagtt agtagaggtg atatcaatcc tactctgaaa aaacttacac 15300  
 ctatagagca ggtgctgatc aattgctggg tggcaattaa cggacctaa ctgtgcaaag 15360  
 aattgatcca ccatgatgtt gcctcagggc aagatggatt gcttaattct atactcatcc 15420  
 tctacagggg gttggcaaga ttcaaagaca accaaagaag tcaacaaggg atgttccacg 15480  
 cttaccccggt attggttaagt agcaggcaac gagaacttat atctaggatc acccgcaaat 15540  
 tttgggggca cattcttctt tactccggga acagaaagtt gataaataag tttatccaga 15600  
 atctcaagtc cggctatctg atactagact tacaccagaa tatcttcgtt aagaatctat 15660  
 ccaagtcaga gaaacagatt attatgacgg ggggtttgaa acgtgagtggt gtttttaagg 15720  
 taacagtcaa ggagaccaa gaatggtata agttagtcgg atacagtgcc ctgattaagg 15780

actaattggg tgaactccgg aaccctaata ctgccctagg tggtaggca ttatttgcaa 15840  
tagattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

<210> 8

<211> 15894

<212> DNA

<213> Measles virus

<400> 8

accaaacaaa gttgggtaag gatagttcaa tcaatgatca tcttctagt cacttaggat 60  
tcaagatcct attatcaggg acaagagcag gattagggat atccgagatg gccacacttt 120  
taaggagcct agcattgttc aaaagaaaca aggacaaacc acccattaca tcaggatccg 180  
gtggagccat cagaggaatc aaacacatta ttatagtacc aatccctgga gattcctcaa 240  
ttaccactcg atccagactt ctggaccggt tggtcagggt aattggaaac ccgagtgatg 300  
gcgggcccaa actaacaggg gcactaatag gtatattatc cttatttggt gagtctccag 360  
gtcaattgat tcagaggatc accgatgacc ctgacgttag cataaggctg ttagagggtg 420  
tccagagtga ccagtcacaa tctggcctta ccttcgcac aagaggtacc aacatggagg 480  
atgaggcggg caaatacttt tcacatgatg atccaattag tagtgatcaa tccagggttcg 540  
gatgggtcga gaacaaggaa atctcagata ttgaagtgca agaccctgag ggattcaaca 600  
tgattctggg taccatccta gcccacattt ggggtcttgc cgcaaaggcg gttacggccc 660  
cagacacggc agctgattcg gagctaagaa ggtggataaa gtacacccaa caaagaaggg 720  
tagttggtga atttagattg gagagaaaat ggttggatgt ggtgaggaac aggattgccg 780  
aggacctctc cttacgccga ttcattggct ctctaactct ggatatcaag agaacacccg 840  
gaaacaaacc caggattgct gaaatgatat gtgacattga tacatatatc gtagaggcag 900  
gattagccag ttttatcctg actattaagt ttgggtaga aactatgtat cctgctcttg 960  
gactgcatga atttgctggg gagttatcca cacttgagtc cttgatgaac ctttaccagc 1020  
aaatggggga aactgcaccc tacatggtaa tcttgagaa ctcaattcag aacaagttca 1080  
gtgcaggatc ataccctctg ctctggagct atgccatggg agtaggagtg gaacttgaaa 1140  
actccatggg aggtttgaac tttggccgat cttactttga tccagcatat tttagattag 1200  
ggcaagagat ggtaaggagg tcagctggaa aggtcagttc cacattggca tctgaactcg 1260  
gtatcactgc cgaggatgca aggcttggtt cagagattgc aatgcatact actgaggaca 1320  
agatcagtag agcggttgga cccagacaag cccaagtatc atttctacac ggtgatcaaa 1380  
gtgagaatga gctaccgaga ttggggggca aggaagatag gaggggtcaa cagagtcgag 1440  
gagaagccag ggagagctac agagaaaccg ggcccagcag agcaagtgat gcgagagctg 1500  
cccatcttcc aaccggcaca cccctagaca ttgacactgc atcggagtcc agccaagatc 1560  
cgcaggacag tcgaaggcca gctgacgccc tgcttaggct gcaagccatg gcaggaatct 1620  
cggaagaaca aggtcagac acggacaccc ctatagtgtg caatgacaga aatcttctag 1680  
actaggtgag agaggccgag gaccagaaca acatccgcct accctccatc attgttataa 1740  
aaaacttagg aaccagggtc acacagccgc cagcccatca accatccact cccacgattg 1800  
gagccgatgg cagaagagca ggcacgccat gtcaaaaacg gactggaatg catccgggct 1860  
ctcaaggccg agcccatcgg ctcaactggc atcgaggaag ctatggcagc atggtcagaa 1920  
atatcagaca acccaggaca ggagcgagcc acctgcaggg aagagaaggc aggcagttcg 1980  
ggtctcagca aacctgcct ctcaagcaat ggatcaactg aaggcgggtg acctcgcatc 2040  
cgcggtcagg gacctggaga gagcgatgac gacgctgaaa ctttgggaat ccccccaaga 2100  
aatctccagg catcaagcac tgggttacag tgttattatg tttatgatca cagcggtgaa 2160  
gcggttaagg gaatccaaga tgctgactct atcatgggtc aatcaggcct tgatgggtgat 2220  
agcacccat caggaggaga caatgaatct gaaaacagcg atgtggatat tggcgaacct 2280  
gataccgagg gatatgctat cactgacggg ggatctgctc ccattctctat ggggttcagg 2340

gcttctgatg ttgaaactgc agaaggaggg gagatccacg agctcctgag actccaatcc 2400  
agaggcaaca actttccgaa gcttgggaaa actctcaatg ttctcccgcc cccggacccc 2460  
ggtagggcca gcacttccgg gacaccatt aaaaaggga cagacgcgag attagcctca 2520  
tttggaaagg agatcgctc tttattgaca ggtggtgcaa cccaatgtgc tcgaaagtca 2580  
ccctcggaa catcagggcc aggtgcacct gcggggaatg tccccgagta tgtgagcaat 2640  
gccgcactga tacaggagtg gacaccgaa tctggtacca caatctcccc gagatcccag 2700  
aataatgaag aagggggaga ctattatgat gatgagctgt tctctgatgt ccaagatatt 2760  
aaaacagcct tggccaaaat acacgaggat aatcagaaga taatctccaa gctagaatca 2820  
ctgctgttat tgaagggaga agttgagtca attaagaagc agatcaacag gcaaaatatc 2880  
agcatatcca ccctggaagg acacctctca agcatcatga tcgccattcc tggacttggg 2940  
aaggatcca acgacccac tgcagatgtc gaaatcaatc ccgacttgaa acccatcata 3000  
ggcagagatt caggccgagc actggccgaa gttctcaaga aaccggttg cagccgacaa 3060  
ctccaaggaa tgacaaatgg acggaccagt tccagaggac agctgctgaa ggaatttcag 3120  
ccaaagccga tcgggaaaaa gatgagctca gccgtcgggt ttgttctga caccggccct 3180  
gcatcacgca gtgtaatccg ctccattata aaatccagcc ggctagagga ggatcggaag 3240  
cgttacctga tgactctect tgatgatata aaaggagcca atgatcttg caagttccac 3300  
cagatgctga tgaagataat aatgaagtag ctacagctca acttacctgc caaccccatg 3360  
ccagtgcacc caactagtac aacctaaatc cattataaaa aacttaggag caaagtgatt 3420  
gcctcccaag ttcacaaatg acagagatct acgacttcca caagtccgca tgggacatca 3480  
aagggtcgat cgctccgata caaccgacca cctacagtga tggcaggctg gtgccccagg 3540  
tcagagtcac agatcctggg ctaggcgaca ggaaggatga atgctttatg tacatgtctc 3600  
tgctgggggt tgttgaggac agcgatcccc tagggcctcc aatcgggcca gcatttgggt 3660  
ccctgcctct aggtgttggc agatccacag caaagcccca aaaactcctc aaagaggcca 3720  
ctgagcttga catagtgtt agacgtacag cagggtcaa tgaaaaactg gtgttctaca 3780  
acaacacccc actaactctc ctacacctt ggagaaagg cctaacaaca gggagtgtct 3840  
tcaacgcaaa ccaagtgtgc aatgcggtta atctgatacc gctcgatacc ccgcagagg 3900  
tccgtgttgt ttatatgagc atcaccctgc tttcggataa cgggtattac accgttctca 3960  
gaagaatgct ggaattcaga tcggtcaatg cagtggcctt caacctgctg gtgacctta 4020  
ggattgacaa ggcgataggc cctgggaaga tcatcgacaa tacagagcaa ctctctgagg 4080  
caacatttat ggtccacatc gggaacttca ggagaaagaa gagtgaagtc tactctgccg 4140  
attattgcaa aatgaaaatc gaaaagatgg gcctgggttt tgcaattggg gggatagggg 4200  
gcaccagtct tcacattaga agcacaggca aaatgagcaa gactctccat gcacaactcg 4260  
ggttcaagaa gaccttatgt taccgctga tggatatcaa tgaagacctt aatcgattac 4320  
tctggaggag cagatgcaag atagtaagaa tccaggcagt tttgcagcca tcagttctc 4380  
aagaattccg catttacgac gacgtgatca taaatgatga ccaaggacta ttcaaagttc 4440  
tgtagaccgt agtgccagc aatgcccga aacgaccccc ctcaaatga cagccagaag 4500  
gcccggacaa aaaagcccc tccgaaagac tccactgacc aagcgagagg ccagccagca 4560  
gccgacggca agcacgaaca ccaggcgcc ccagcacaga acagccctga tacaaggcca 4620  
ccaccagcca cccaatctg catctctctc gtgggacccc cgaggaccaa cccccaaggc 4680  
tgccccgat ccaaaccacc aaccgcatcc ccaccacccc cgggaaagaa acccccagca 4740  
attggaaggc cctccccct ctctctcaac acaagaactc cacaaccgaa ccgcacaagc 4800  
gaccgaggtg acccaaccgc aggcattcga ctccctagac agatcctctc tccccggcaa 4860  
actaaacaaa acttagggcc aaggaaacata cacaccaaac agaaccaga ccccggccca 4920  
cggcgccgcg ccccaaccc ccgacaacca gagggagccc ccaaccaatc ccgccggctc 4980  
ccccggtgcc cacaggcagg gacaccaacc cccgaacaga cccagcacct aaccatcgac 5040  
aatccaagac gggggggccc ccccaaaaaa agggccccag gggccgacag ccagcacgcg 5100  
gaggaagccc acccacccca cacacgacca cggcaaccaa accagaaccc agaccaccct 5160  
gggccaccag ctcccagact cggccatcac cccgcagaaa ggaaaggcca caaccgcgcg 5220

accccagccc cgatccggcg gggagccacc caaccggaac cagcacccaa gagcgatccc 5280  
 cgaaggaccc ccgaaccgca aaggacatca gtatcccaca gcctctccaa gtcccccggt 5340  
 ctctctctct tctcgaaggg accaaaagat caatccacca caccgcagca cactcaactc 5400  
 cccaccctta aaggagacac cgggaatccc agaatcaaga ctcatccaat gtccatcatg 5460  
 ggtctcaagg tgaacgtctc tgccatattc atggcagtac tggttaactct ccaaaccacc 5520  
 accggtcaaa tccattgggg caatctctct aagatagggg tggtaggaat aggaagtgc 5580  
 agctacaaag ttatgactcg ttccagccat caatcattag tcataaaatt aatgcccatt 5640  
 ataactctcc tcaataactg cagcagggtg gagattgcag aatacaggag actactgaga 5700  
 acagttttgg aaccaattag agatgcactt aatgcaatga cccagaatat aagaccggtt 5760  
 cagagtgtag cttcaagtag gagacacaag agatttgccg gagtagtcct ggcagggtgcg 5820  
 gccctaggcg ttgccacagc tgctcagata acagccggca ttgcacttca ccagtccatg 5880  
 ctgaactctc aagccatcga caatctgaga gcgagcctgg aaactactaa tcaggcaatt 5940  
 gaggcaatca gacaagcagg gcaggagatg atattggctg ttcagggtgt ccaagactac 6000  
 atcaataatg agctgatacc gtctatgaac caactatctt gtgatttaat cggccagaag 6060  
 ctccggctca aattgctcag atactatata gaaatcctgt cattatttgg cccagctta 6120  
 cgggacccca tatctgcgga gatatctatc caggctttga gctatgcgt tggaggagac 6180  
 atcaataagg tgtagaaaa gctcggatag agtggaggtg atttactggg catcttagag 6240  
 agcagaggaa taaaggcccg gataactcac gtcgacacag agtcctactt cattgtcctc 6300  
 agtatagcct atccgacgct gtccgagatt aagggggtga ttgtccaccg gctagagggg 6360  
 gtctcgtaca acataggctc tcaagagtgg tataccactg tgcccaagta tgttgcaacc 6420  
 caagggtacc ttatctcgaa ttttgatgag tcatcgtgta ctttcatgcc agaggggact 6480  
 gtgtgcagcc aaaaatgcctt gtacccgatg agtcctctgc tccaagaatg cctccggggg 6540  
 tacaccaagt cctgtgctcg tacactcgta tccgggtctt ttgggaaccg gttcatttta 6600  
 tcacaaggga acctaatagc caattgtgca tcaatccttt gcaagtgtta cacaacagga 6660  
 acgatcatta atcaagaccc tgacaagatc ctaacatata ttgctgccga taactgcccg 6720  
 gtagtcgagg tgaacggcgt gaccatccaa gtccggagca ggaggtatcc agacgctgtg 6780  
 tacttgacac gaattgacct cggctctccc atattattgg agaggttggg cgtagggaca 6840  
 aatctgggga atgcaattgc taagtgtgag gatgccagg aattgttggg gtcacggac 6900  
 cagatattga ggagtatgaa aggtttatcg agcacttgca tagtctacat cctgattgca 6960  
 gtgtgtcttg gaggtttgat agggatcccc gctttaatat gttgctgcag ggggcgtgtg 7020  
 aacaaaaagg gagaacaagt tggtagtca agaccaggcc taaagcctga tcttacggga 7080  
 acatcaaaat cctatgtaag gtcgctctga tctctacaa ctcttgaaac acaaagtcc 7140  
 cacaagtctc ctcttcgtca tcaagcaacc accgcacca gcatcaagcc cactgaaat 7200  
 tatctccggc ttccctctgg ccgaacaata tcggtagtta attaaaactt aggggtgcaag 7260  
 atcatccaca atgtcaccac aacgagaccg gataaatgcc ttctacaaag ataaccacca 7320  
 tccaaggga agtaggatag tcattaacag agaacatctt atgattgata gaccttatgt 7380  
 tttgctggct gttctgtttg tcatgtttct gagcttgatc ggggttgctag ccattgcagg 7440  
 cattagactt catcgggcag ccactacac cgcagagatc cataaaagcc tcagcacc 7500  
 tctagatgta actaactcaa tcgagcatca ggtcaaggac gtgctgacac cactcttcaa 7560  
 aatcatcggt gatgaagtgg gcctgaggac acctcagaga ttcactgacc tagtgaaatt 7620  
 catctctgac aagattaaat tccttaatcc ggataggag tacgacttca gagatctcac 7680  
 ttggtgtatc aaccgccag agagaatcaa attggattat gatcaatact gtgcagatgt 7740  
 ggctgctgaa gagctcatga atgcattggg gaactcaact ctactggaga ccagaacaac 7800  
 caatcagttc ctagtgtct caaagggaaa ctgctcaggg cccactacaa tcagaggtca 7860  
 attctcaaac atgtcgtgt ccctgttaga cttgtattta ggtcgaggtt acaatgtgtc 7920  
 atctatagtc actatgacat cccagggaat gtatggggga acttacctag tggaaaagcc 7980  
 taatctgagc agcaaaaggc cagagtgtgc acaactgagc atgtaccgag tgtttgaagt 8040  
 aggtgttatc agaaatccgg gtttgggggc tccggtgttc catatgacaa actatcttga 8100

gcaaccagtc agtaatgac tcagcaactg tatggtggct ttgggggagc tcaaactcgc 8160  
 agccctttgt caccgggaag attctatcac aattccctat cagggatcag ggaaagggtg 8220  
 cagcttccag ctctgaagc taggtgtctg gaaatcccca accgacatgc aatccctggg 8280  
 caccttatca acggatgac cagtgtatga caggctttac ctctcatctc acagagggtg 8340  
 tatcgctgac aatcaagcaa aatgggctgt cccgacaaca cgaacagatg acaagttgcg 8400  
 aatggagaca tgcttccaac aggcgtgtaa gggtaaaatc caagcactct gcgagaatcc 8460  
 cgagtgggca ccattgaagg ataacaggat tccttcatac ggggtcttgt ctgttgatct 8520  
 gagtctgaca gttgagctta aaatcaaaat tgcttcggga ttcgggccat tgatcacaca 8580  
 cggttcaggg atggacctat acaaatccaa ccacaacaat gtgtattggc tgactatccc 8640  
 accaatgaag aacctagcct taggtgtaat caacacattg gagtggatac cgagattcaa 8700  
 ggtagtccc tacctcttca atgtcccaat taagggaagca gggaagact gccatgcccc 8760  
 aacataccta cctgcggagg tggatggtga tgtcaaaactc agttccaatc tgggtattct 8820  
 acctggtcaa gatctccaat atgttttggc aacctacgat acttccaggg ttgaacatgc 8880  
 tgtggtttat tacgtttaca gcccagccg ctcatcttct tactttttatc cttttaggtt 8940  
 gcctataaag ggggtcccca tcgaattaca agtggaatgc ttcacatggg accaaaaact 9000  
 ctggtgccgt cacttctgtg tgcttgcgga ctcagaatct ggtggacata tcactcactc 9060  
 tgggatgggtg ggcatgggag tcagctgcac agtcaccgga gaagatggaa ccaatcgag 9120  
 atagggtgctg tagtgaacta atctcatgat gtcaccaga catcaggcat acccactagt 9180  
 gtgaaataga catcagaatt aagaaaaacg tagggtccaa gtggttcccc gttatggact 9240  
 cgctatctgt caaccagatc ttataccctg aagttcacct agatagcccg atagttacca 9300  
 ataagatagt agccatcctg gagtatgtc gagtccctca cgcttacagc ctggaggacc 9360  
 ctacactgtg tcagaacatc aagcaccgcc taaaaaacgg attttccaac caaatgatta 9420  
 taaacaatgt ggaagtggg aatgtcatca agtccaagct taggagttat ccggccact 9480  
 ctcatattcc atatccaaat tgtaatcagg atttatttaa catagaagac aaagagtcaa 9540  
 cgaggaagat ccgtgaactc ctcaaaaagg ggaattcgct gtactccaaa gtcagtgata 9600  
 aggttttcca atgcttaagg gacactaact cagggttg cctaggctcc gaattgaggg 9660  
 aggacatcaa ggagaaagt attaacttg gagttacat gcacagctcc cagtggttt 9720  
 agccctttct gttttgggtt acagtcaaga ctgagatgag gtcagtgatt aaatcacaaa 9780  
 cccatacttg ccataggagg agacacacac ctgtattctt cactggtagt tcagttgagt 9840  
 tgctaattctc tcgtgacctt gttgctataa tcagtaaaga gtctcaacat gtatattacc 9900  
 tgacatttga actgggtttg atgtattgtg atgtcataga ggggaggtta atgacagaga 9960  
 ccgctatgac tattgatgct aggtatacag agcttctagg aagagtcaga tacatgtgga 10020  
 aactgataga tggtttcttc cctgcactcg ggaatccaac ttatcaaatt gtagccatgc 10080  
 tggagcctct ttcacttgct tacctgcagc tgagggatat aacagtagaa ctgagagggtg 10140  
 ctttctctaa cactgcttt actgaaatac atgatgttct tgacaaaaac ggggtttctg 10200  
 atgaaggtag ttatcatgag ttaattgaag ctctagatta cattttcata actgatgaca 10260  
 tacatctgac aggggagatt ttctcatttt tcagaagttt cggccacccc agacttgaag 10320  
 cagtaacggc tgctgaaaat gttaggaaat acatgaatca gcctaaagtc atttgttatg 10380  
 agactctgat gaaaggatc gccatatttt gtggaatcat aatcaacggc tatcgtgaca 10440  
 ggcacggagg cagttggcca ccgtgaccc tccccctgca tgctgcagac acaatccgga 10500  
 atgctcaagc ttcagggtgaa ggggttaacac atgagcagtg cgttgataac tggaaatctt 10560  
 ttgctggagt gaaatttggc tgctttatgc ctcttagcct ggatagtgat ctgacaatgt 10620  
 acctaaagga caaggcactt gctgctctcc aaagggaatg ggattcagtt taccgaaaag 10680  
 agttcctgcg ttacgacct cccaaggga ccgggtcacg gaggttgta gatgttttcc 10740  
 ttaatgattc gagctttgac ccatatgatg tgataatgta tgttgtaagt ggagcttacc 10800  
 tccatgacct tgagttcaac ctgtcttaca gcctgaaaga aaaggagatc aaggaaacag 10860  
 gtagactttt tgctaaaatg acttacaaaa tgagggcag ccaagtgatt gctgaaaatc 10920  
 taatctcaaa cgggattggc aaatatttta aggacaatgg gatggccaag gatgagcacg 10980

atttgactaa ggcactccac actctagctg tctcaggagt ccccaaagat ctcaaagaaa 11040  
 gtcacagggg ggggccagtc ttaaaaacct actcccgaag cccagtcac acaagtacca 11100  
 ggaacgtgag agcagcaaaa gggtttatag ggttccctca agtaattcgg caggaccaag 11160  
 aactgatca tccggagaat atggaagctt acgagacagt cagtgcattt atcacgactg 11220  
 atctcaagaa gtactgcctt aattggagat atgagaccat cagcttggtt gcacagaggc 11280  
 taaatgagat ttacggattg cctcattttt tccagtggct gcataagagg cttgagacct 11340  
 ctgtcctgta tgtaagtga cctcattgcc ccccgcacct tgacgccccat atcccgttat 11400  
 ataaagtccc caatgatcaa atcttcatta agtaccctat gggagggtata gaagggtatt 11460  
 gtcagaagct gtggaccatc agcaccattc cctatctata cctggctgct tatgagagcg 11520  
 gagtaaggat tgcttcgtta gtgcaagggg acaatcagac catagccgta acaaaaaggg 11580  
 taccagcac atggccctac aaccttaaga aacgggaagc tgctagagta actagagatt 11640  
 actttgtaat tcttaggcaa aggtacatg atattggcca tcacctcaag gcaaagtga 11700  
 caattgtttc atcacatttt tttgtctatt caaaaggaat atattatgat gggctacttg 11760  
 tgtcccaatc actcaagagc atcgcaagat gtgtattctg gtcagagact atagttgatg 11820  
 aaacaagggc agcatgcagt aatattgcta caacaatggc taaaagcatc gagagagggt 11880  
 atgaccgtta ccttgcatat tccctgaacg tccataaagt gatacagcaa attctgatct 11940  
 ctcttggtt cacaatcaat tcaaccatga cccgggatgt agtcataccc ctccctacaa 12000  
 acaacgacct cttaataagg atggcactgt tgcccgtctc tattgggggg atgaattatc 12060  
 tgaatatgag caggctgttt gtcagaaaca tcggtgatcc agtaacatca tcaattgctg 12120  
 atctcaagag aatgattctc gcctcactaa tgctgaaga gaccctccat caagtaatga 12180  
 cacaacaacc gggggactct tcatcctag actgggctag cgacccttac tcagcaaatc 12240  
 ttgtatgtgt ccagagcatc actagactcc tcaagaacat aactgcaagg tttgtcctga 12300  
 tccatagtcc aaacccaatg taaaaggat tattccatga tgacagtaaa gaagaggacg 12360  
 agggactggc ggcattctc atggacaggc atattatagt acctagggca gctcatgaaa 12420  
 tcctggatca tagtgtcaca ggggcaagag agtctattgc aggcagtctg gataccacaa 12480  
 aaggcctgat tcgagccagc atgaggaagg ggggggttaac ctctcgagtg ataaccagat 12540  
 tgtccaatta tgactatgaa caattcagag cagggtggt gctattgaca ggaagaaaga 12600  
 gaaatgtcct cattgacaaa gagtcatgtt cagtgcagct ggcgagagct ctaagaagcc 12660  
 atatgtgggc gaggctagct cgaggacggc ctatttacgg ccttgaggtc cctgatgtac 12720  
 tagaatctat gcgaggccac cttattcggc gtcagagac atgtgtcatc tgcgagtgtg 12780  
 gatcagtc aa ctacggatgg tttttgtcc cctcgggttg ccaactggat gatattgaca 12840  
 aggaacatc atccttgaga gtcccatata ttggttctac cactgatgag agaacagaca 12900  
 tgaagcttgc cttcgtaaga gcccgaagtc gatccttgcg atctgctgtt agaatagcaa 12960  
 cagtgtactc atgggcttac ggtgatgatg atagctcttg gaacgaagcc tgggtgttg 13020  
 ctaggcaaaag ggccaatgtg agcctggagg agctaagggt gatcactccc atctcaactt 13080  
 cgactaattt agcgcatagg ttgaggatc gtagcactca agtgaaatac tcagggtacat 13140  
 cccttgctcg agtggcgagg tataccacaa tctccaacga caatctctca tttgtcatat 13200  
 cagataagaa ggttgatact aactttatat accaacaagg aatgcttcta ggggtgggtg 13260  
 ttttagaaac attgtttcga ctcgagaaag ataccggatc atctaacacg gtattacatc 13320  
 ttacagtcga aacagattgt tgcgtgatcc cgatgataga tcatcccagg ataccagct 13380  
 cccgcaagct agagctgagg gcagagctat gtaccaaccc attgatatat gataatgcac 13440  
 ctttaattga cagagataga acaaggctat acaccagag ccataggagg caccttggtg 13500  
 aatttggttac atggtccaca cccaactat atcacatttt agctaagtcc acagcactat 13560  
 ctatgattga cctggaataa aaatttgaga aggaccatat gaatgaaatt tcagctctca 13620  
 taggggatga cgatatcaat agtttcataa ctgagtttct gctcatagag ccaagattat 13680  
 tcactatcta cttgggcccag tgtgcccga tcaattgggc atttgatgta cattatcata 13740  
 gaccatcagg gaaatatcag atgggtgagc tgtgtcatc gttcctttct agaattagca 13800  
 aaggagtgtt taagggtgct gtcaatgctc taagccaccc aaagatctac aagaaattct 13860

```

ggcattgtgg tattatagag cctatccatg gtccttcact tgatgctcaa aacttgca 13920
caactgtgtg caacatgggt tacacatgct atatgaccta cctcgacctg ttgttgaatg 13980
aagagttaga agagttcaca tttctcttgt gtgaaagcga cgaggatgta gtaccggaca 14040
gattcgacaa catccaggca aaacacttat gtgttctggc agatttgtac tgtcaaccag 14100
gggcctgccc accaattcga ggtctaagac cggtagagaa atgtgcagtt ctaaccgacc 14160
atatcaaggc agaggctagg ttatctccag caggatcttc gtggaacata aatccaatta 14220
ttgtagacca ttactcatgc tctctgactt atctccggcg aggatcgatc aaacagataa 14280
gattgagagt tgatccagga ttcatTTTTcg acgccctcgc tgaggtaaat gtcagtcagc 14340
caaagatcgg cagcaacaac atctcaaata tgagcatcaa ggctttcaga cccccacag 14400
atgatgttgc aaaattgctc aaagatatca acacaagcaa gcacaatctt cccatttcag 14460
ggggcaatct cgccaattat gaaatccatg ctttccgcag aatcgggttg aactcatctg 14520
cttgctacaa agctgttgag atatcaacat taattaggag atgccttgag ccagggggagg 14580
acggcttggt cttgggtgag ggatcgggtt ctatgttgat cacttataag gagatactta 14640
aactaaacaa gtgcttctat aatagtgggg tttccgcaa ttctagatct ggtcaaagg 14700
aattagcacc ctatccctcc gaagtggcc ttgtcgaaca cagaatggga gtaggtaata 14760
ttgtcaaagt gctctttaac gggaggcccg aagtcacgtg ggtaggcagt gtagattgct 14820
tcaatttcat agttagtaat atccctacct ctagtgtggg gtttatccat tcagatatag 14880
agaccttgcc taacaaagat actatagaga agctagagga attggcagcc atcttatcga 14940
tggtctgct cctgggcaaa ataggatcaa tactggtgat taagcttatg ctttccagcg 15000
gggattttgt tcagggattt ataagttatg tagggtctta ttatagagaa gtgaaccttg 15060
tataccctag atacagcaac ttcatatcta ctgaatctta tttggttatg acagatctca 15120
aggctaaccg gctaataaat cctgaaaaga ttaagcagca gataattgaa tcatctgtga 15180
ggacttcacc tggacttata ggtcacatcc tatccattaa gcaactaagc tgcatacaag 15240
caattgtggg agacgcagtt agtagagggt atatcaatcc tactctgaaa aaacttacac 15300
ctatagagca ggtgctgac aattgcgggt tggcaattaa cggacctaa ctgtgcaaag 15360
aattgatcca ccatgatgtt gcctcagggc aagatggatt gcttaattct atactcatcc 15420
tctacaggga gttggcaaga ttcaaagaca accgaagaag tcaacaaggg atgttccacg 15480
cttaccctgt attggtagt agcaggcaac gagaacttat atctaggatc acccgcaaat 15540
tttgggggca cattcttctt tactccggga acagaaagt gataaataag tttatccaga 15600
atctcaagtc cggctatctg atactagact tacaccagaa tatcttcgtt aagaatctat 15660
ccaagtcaga gaaacagatt attatgacgg ggggtttgaa acgtgagtgg gtttttaagg 15720
taacagtcaa ggagaccaa gaatggtata agttagtcgg atacagtgcc ctgattaagg 15780
actaattgat tgaactcgg aaccctaate ctgccctagg tggtaggca ttatttgcaa 15840
tatattaaag aaaactttga aaatacgaag tttctattcc cagctttgtc tgggt 15894

```

<210> 9

<211> 15218

<212> DNA

<213> respiratory syncytial virus

<400> 9

```

acgcgaaaa atgcgtacta caaacttgca cattcgaaaa aaatggggca aataagaact 60
tgataagtgc tatttaagtc taaccttttc aatcagaaat ggggtgcaat tcaactgagca 120
tgataaagggt tagattacaa aatttatTTTg acaatgacga agtagcattg ttaaaaataa 180
catgttatatc tgataaatta attcttctga ccaatgcatt agccaaagca gcaatacata 240
caattaaatt aaacggcata gtttttatatc atgtttataac aagcagtga gttgtgccctg 300
ataacaatat tgtagtgaaa tctaacttta caacaatgcc aatactacaa aatggaggat 360
acatatggga attgattgag ttgacacact gctctcaatt aaacgggttta atggatgata 420

```



```

attgtgaaat caaatTTTct aaaagactaa gtgactcagt aatgactaat tatatgaatc 480
aaatatctga cttacttggg cttgatctca attcatgaat tatgttttagt ctaattcaat 540
agacatgtgt ttattaccat tttagttaat ataaaaactc atcaaaggga aatggggcaa 600
ataaactcac ctaatcaatc aaaccatgag cactacaaat gacaacacta ctatgcaaag 660
attgatgatac acagacatga gacccttctc aatggattca ataataacat ctcttaccaa 720
agaaatcatc acacacaaat tcatatactt gataaacaat gaatgtattg taagaaaact 780
tgatgaaaga caagctacat ttacattctt agtcaattat gagatgaagc tactgcacaa 840
agtagggagt accaaatata aaaaatacac tgaatataat acaaaatatg gcactttccc 900
catgcctata tttatcaatc acggcgggtt tctagaatgt attggcatta agcctacaaa 960
acacactcct ataatatata aatatgacct caaccctga attccaacaa aaaaaccaac 1020
ccaaccaaac caaactattc ctcaaacaac agtgctcaat agttaagaag gagctaattc 1080
atttttagtaa ttaaaaaataa aagtaaagcc aataacataa attggggcaa atacaaagat 1140
ggctcttagc aaagtcaagt tgaatgatac attaaataag gatcagctgc tgtcatccag 1200
caaatacact attcaacgta gtacaggaga taatattgac actcccaatt atgatgtgca 1260
aaaacaccta aacaaactat gtggtatgct attaatcact gaagatgcaa atcataaatt 1320
cacaggatta ataggtatgt tatatgctat gtccagggtta ggaagggaag acactataaa 1380
gatacttaaa gatgctggat atcatgttaa agctaagga gtagatataa caacatatcg 1440
tcaagatata aatggaaagg aaatgaaatt cgaagtatta acattatcaa gcttgacatc 1500
agaaatacaa gtcaatattg agatagaatc tagaaagtcc tacaaaaaaa tgctaaaaga 1560
gatgggagaa gtggctccag aatataggca tgattctcca gactgtggga tgataatact 1620
gtgtatagct gcacttgtga taaccaaatt agcagcagga gacagatcag gtcttacagc 1680
agtaattagg agggcaaaca atgtcttaaa aaacgaaata aaacgataca agggcctcat 1740
accaaaggat atagctaaca gtttttatga agtgtttgaa aaacacctc atcttataga 1800
tgttttcgtg cactttggca ttgcacaatc atccacaaga gggggtagta gaggttgaag 1860
aatctttgca ggattgttta tgaatgccta tggttcaggg caagtaatgc taagatggg 1920
agttttagcc aaatctgtaa aaaatatcat gctaggacat gctagtgtcc aggcagaaat 1980
ggagcaagtt gtggaagtct atgagtatgc acagaagttg ggaggagaag ctggattcta 2040
ccatatattg aacaatccaa aagcatcatt gctgtcatta actcaatttc ccaacttctc 2100
aagtgtggtc ctaggcaatg cagcaggtct aggcataatg ggagagtata gaggtagacc 2160
aagaaaccag gatctttatg atgcagctaa agcatatgca gagcaactca aagaaaatgg 2220
agtaataaac tacagtgtat tagacttaac agcagaagaa ttggaagcca taaagcatca 2280
actcaacccc aaagaagatg atgtagagct ttaagttaac aaaaaatacg gggcaaataa 2340
gtcaacatgg agaagtttgc acctgaattt catggagaag atgcaaataa caaagctacc 2400
aaattcctag aatcaataaa gggcaagttc gcatcatcca aagatcctaa gaagaaagat 2460
agcataatat ctgttaactc aatagatata gaagtaacta aagagagccc gataacatct 2520
ggcaccaaca tcatcaatcc aacaagtga gcccagagta ccccagaaac aaaagccaac 2580
taccgaagaa aaccttagt aagcttcaaa gaagatctca cccaagtga caacctttt 2640
tctaagttgt acaaggaaac aatagaaaca tttgataaca atgaagaaga atctagctac 2700
tcatatgaag agataaatga tcaaacaat gacaacatta cagcaagact agatagaatt 2760
gatgaaaaat taagtgaat attaggaatg ctccatacat tagtagttgc aagtgcagga 2820
cccacttcag ctgcgatgg aataagagat gctatgggtg gtctaagaga agagatgata 2880
gaaaaaataa gagcggaagc attaatgacc aatgataggt tagaggctat ggcaagactt 2940
aggaatgagg aaagcgaaaa aatggcaaaa gacacctcag atgaagtgtc tcttaatcca 3000
acttccaaaa aattgagtga cttgttgga gacaacgata gtgacaatga tctatcactt 3060
gatgattttt gatcagcgat caactcactc agcaatcaac aacatcaata aaacagacat 3120
caatccattg aatcaactgc cagaccgaac aaacaaacgt ccatcagtag aaccaccaac 3180
caatcaatca accaattgat caatcagcaa cccgacaaaa ttaacaatat agtaacaaaa 3240
aaagaacaag atggggcaaa tatggaaaca tacgtgaaca agcttcacga aggtccaca 3300

```

tacacagcag ctgttcagta caatgttcta gaaaaagatg atgatcctgc atcactaaca 3360  
 atatgggtgc ctatgttcca gtcattctgtg ccagcagact tgctcataaa agaacttgca 3420  
 agcatcaata tactagtga gacagatctct acgcccagaag gaccttcact acgagtcacg 3480  
 attaactcaa gaagtgtgtg gctggctcaa atgcctagta atttcatcat aagcgcaaat 3540  
 gtatcattag atgaaagaag caaattagca tatgatgtaa ctacaccttg tgaaatcaaa 3600  
 gcatgcagtc taacatgctt aaaagtaaaa agtatgttaa ctacagtc aaatccttacc 3660  
 atgaagacat tcaacccac tcatgagatc attgctctat gtgaatttga aaatattatg 3720  
 acatcaaaaa gagtaataat accaacctat ctaagatcaa ttagtggtcaa gaacaaggat 3780  
 ctgaactcac tagaaaatat agcaaccacc gaattcaaaa atgctatcac caatgcaaaa 3840  
 attattcctt atgcaggatt agtggttagtt atcacagtta ctgacaataa aggagcattc 3900  
 aaatatatca aaccacagag tcaatttata gtagatcttg gtgcctacct agaaaaagag 3960  
 agcatatat atgtgactac taattggaag catacagcta cacgtttttc aatcaaacca 4020  
 ctagaggatt aaacttaatt atcaaacctg aatgacaggt ccacatatat cctcaaacta 4080  
 cacactatat ccaaacatca taaacatcta cactacacac ttcattcacac aaaccaatcc 4140  
 cactcaaaat ccaaaatcac taccagccac tatctgctag acctagagtg cgaataggta 4200  
 aataaaacca aaatatgggg taaatagaca ttagttagag ttcaatcaat cttacaacc 4260  
 atttataccg ccaattcaac acatatacta taaatcttaa aatgggaaat acatccatca 4320  
 caatagaatt cacaagcaaa ttttggccct attttacact aatacatatg atcttaactc 4380  
 taatcttttt actaattata atcactatta tgattgcaat actaaataag ctaagtgaac 4440  
 ataaagcatt ctgtaacaaa actcttgaa ctaggacagat gtatcaaatc aacacataga 4500  
 gttctaccat tatgtgtgtg caaattataa tcctgtatat ataaacaaac aaatccaatc 4560  
 ttctcacaga gtcattggtg cgcaaaacca cgtaactat catggttagca tagagtagtt 4620  
 atttaaaaat taacataatg atgaattgtt agtatgagat caaaaacaac attggggcaa 4680  
 atgcaaccat gtccaaacac aagaatcaac gcactgccag gactctagaa aagacctggg 4740  
 atactcttaa tcatctaat gtaatatct cttgtttata cagattaaat ttaaaatcta 4800  
 tagcacaat agcactatca gttttggcaa tgataatctc aacctctctc ataattgcag 4860  
 ccataatatt catcatctct gccaatcaca aagttacact aacaacggtc acagttcaaa 4920  
 caataaaaaa ccacactgaa aaaaacatca ccacctacc tactcaagtc tcaccagaaa 4980  
 gggttagttc atccaagcaa cccacaacca catcaccaat ccacacaagt tcagctacaa 5040  
 catcacccaa taaaaaatca gaaacacacc atacaacagc acaaaccaaa ggcagaacca 5100  
 ccacttcaac acagaccaac aagccaagca caaaaccacg tccaaaaaat ccaccaaaaa 5160  
 aagatgatta ccattttgaa gtgttcaact tcgttccctg cagtatatgt ggcaacaatc 5220  
 aactttgcaa atccatctgc aaaacaatac caagcaacaa accaaagaag aaaccaacca 5280  
 tcaaacccac aaacaaacca accaccaaaa ccacaaacaa aagagacca aaaacaccag 5340  
 ccaaacgac gaaaaaagaa actaccacca acccaacaaa aaaactaacc ctcaagacca 5400  
 cagaaagaga caccagcacc tcacaatcca ctgcactcga cacaaccaca ttaaaacaca 5460  
 cagtccaaca gcaatccctc ctctcaacca ccccgaaaa cacaccaac tccacacaaa 5520  
 caccacagc atccgagccc tccacacaa actccacca aaaaaccag ccacatgctt 5580  
 agttattcaa aaactacatc ttagcagaga accgtgatct atcaagcaag aacgaaatta 5640  
 aacctggggc aaataaccat ggagttgatg atccacaagt caagtgcaat cttcctaact 5700  
 cttgtattta atgcattgta cctcacctca agtcagaaca taactgagga gttttacca 5760  
 tcgacatgta gtgcagttag cagaggttat ttagtgctt taagaacagg ttggtatact 5820  
 agtgcataa caatagaatt aagtaataa aaagaaacca aatgcaatgg aactgacact 5880  
 aaagtaaac ttatgaaaca agaattagat aagtataaga atgcagtaac agaattacag 5940  
 ctacttatgc aaaacacacc agctgtcaac aaccgggcca gaagagaagc accacagtat 6000  
 atgaactaca caatcaatac cactaaaaac ctaaatgtat caataagcaa gaagaggaaa 6060  
 cgaagatttc taggcttctt gttaggtgtg ggatctgcaa tagcaagtgg tatagctgta 6120  
 tcaaaagttc tacaccttga aggagaagtg aacaagatca aaaatgcttt gttgtctaca 6180

aacaaagctg tagtcagttt atcaaatggg gtcagtgttt taaccagcaa agtggttagat 6240  
ctcaagaatt acataaataa ccaattatta cccatagtaa atcaacagag ctgtcgcac 6300  
tccaacattg aaacagttat agaattccag cagaagaaca gcagattggt ggaaatcacc 6360  
agagaattta gtgtcaatgc aggtgtaaca acacctttaa gcacttacat gttgacaaac 6420  
agtgagttac tatcattaat caatgatatg cctataacaa atgatcagaa aaaattaatg 6480  
tcaagcaatg ttcagatagt aaggcaacaa agttattcca tcatgtctat aataaaggaa 6540  
gaagtccctg catatgttgt acagctgcct atctatggtg taatagatac accttgctgg 6600  
aaattgcaca catcgcctct atgcactacc aacatcaaag aaggatcaaa tatttgttta 6660  
acaaggactg atagaggatg gtattgtgat aatgcaggat cagtatcctt ctttccacag 6720  
gtgacactt gtaaagtaca gtccaatcga gtattttgtg acactatgaa cagtttgaca 6780  
ttaccaagtg aagtcagcct ttgtaacact gacatattca attccaagta tgactgcaa 6840  
attatgacat caaaaacaga cataagcagc tcagtaatta cttctcttgg agctatagtg 6900  
tcatgctatg gtaaaactaa atgcactgca tccaacaaa atcgtgggat tataaagaca 6960  
ttttctaatg gttgtgacta tgtgtcaaac aaaggagtag atactgtgtc agtgggcaac 7020  
actttatact atgtaaaciaa gctggaaggc aagaacctt atgtaaaagg ggaacctata 7080  
ataaattact atgacctct agtgtttct tctgatgagt ttgatgcac aatatctcaa 7140  
gtcaatgaaa aatcaatca aagtttagct tttattcgta gatctgatga attactacat 7200  
aatgtaata ctggcaaatc tactacaaat attatgataa ctacaattat tatagtaac 7260  
attgtagtat tgttatcatt aatagctatt ggtttactgt tgtattgtaa agccaaaaac 7320  
acaccagtta cactaagcaa agaccaacta agtggaatca ataatttgc attcagcaa 7380  
tagacaaaaa accacctgat catgtttcaa caacaatctg ctgaccacca atcccaaatc 7440  
aacttacaac aaatatttca acatcacagt acaggctgaa tcatttcctc acatcatgct 7500  
accacataa ctaagctaga tccttaactt atagttacat aaaaacctca agtatcaca 7560  
tcaaccacta aatcaacaca tcattcaca aattaacagc tggggcaaat atgtcgcgaa 7620  
gaaatccttg taaatttgag attagaggtc attgcttgaa tggtagaaga tgtcactaca 7680  
gtcataatta ctttgaatgg ctcctcatg cattactagt gaggcaaac ttcattgtaa 7740  
acaagatact caagtcaatg gacaaaagca tagacactt gtctgaaata agtggagctg 7800  
ctgaactgga tagaacagaa gaatatgtc ttggtatagt tggagtgtc gagagttaca 7860  
taggatctat aaacaacata acaaaacat cagcatgtgt tgctatgagt aaacttctta 7920  
ttgatgcaa tagtgatgac attaaaaagc ttagagataa tgaagaacc aattcaccta 7980  
agataagagt gtacaatact gttatatcat acattgagag caatagaaa aacaacaagc 8040  
aaaccatcca tctgtcgaag agactaccag cagacgtgct gaagaagaca ataaagaaca 8100  
cattagatat ccacaaaagc ataaccataa gcaatccaa agagtcaact gtgaatgatc 8160  
aaaatgacca aaccaaaaat aatgatatta cggataaat atcctttag tatatcatcc 8220  
atattgatct caagtgaag catggttgct acattcaatc ataaaaacat attacaattt 8280  
aaccataact atttgataa ccaccagcgt ttattaaatc atatatattga tgaattcat 8340  
tggacaccta aaaacttatt agatgccact caacaatttc tccaacatct taacatccct 8400  
gaagatatat atacagtata tatattagtg tcataatgct tgaccataac gactctatgt 8460  
catccaacca taaaactatt ttgataaggc tatgggacaa aatggatccc attattaatg 8520  
gaaactctgc taatgtgtat ctaactgata gttattttaa aggtgttatc tcttttccag 8580  
agtgaatgc tttaggaggt tatcttttta acggccctta tcttaaaaat gattacacca 8640  
acttaattag tagacaaagc ccactactag agcatatgaa tcttaaaaaa ctaactataa 8700  
cacagtcatt aatatctaga tatcataaag gtgaactgaa attagaagaa ccaacttatt 8760  
tccagtcatt acttatgaca tataaaagta tgcctcgtc tgaacaaatt gctacaacta 8820  
acttacttaa aaaaataata cgaagagcca tagaaataag tgatgtaaag gtgtacgcca 8880  
tcttgaataa actaggatta aaggaaaagg acagagttaa gcccaacaat aattcagtg 8940  
atgaaaactc agtacttaca accataatta aagatgatat actttcggct gtggaaaaca 9000  
atcaatcata tacaattca gacaaaagtc actcagtaaa tcaaatatc actatcaaaa 9060

caacactctt gaaaaaattg atgtgttcaa tgcaacatcc tccatcatgg ttaatacact 9120  
 ggttcaattt atatacaaaa ttaaataaca tattaacaca atatcgatca aatgaggtaa 9180  
 aaagtcattg gtttatatta atagataatc aaactttaag tggttttcag tttattttta 9240  
 atcaatatgg ttgtatcggt tatcataaag gactcaaaaa aatcacaaact actacttaca 9300  
 atcaattttt gacatggaaa gacatcagcc ttagcagatt aaatgtttgc ttaattactt 9360  
 ggataagtaa ttgttttaaat acattaaaca aaagcttagg gctgagatgt ggattcaata 9420  
 atgttgtgtt atcacaaatta tttctttatg gagattgtat actgaaatta tttcataatg 9480  
 aaggcttcta cataataaaa gaagtagagg gatttattat gtctttaatt ctaaacataa 9540  
 cagaagaaga tcaatttagg aaacgatttt ataatagcat gctaaataac atcacagatg 9600  
 cagctattaa ggctcaaaaag gacctactat caagagtatg tcacacttta ttagacaaga 9660  
 cagtgtctga taatatcata aatggtaaat ggataatcct attaaagtaa tttcttaaat 9720  
 tgattaagct tgcagggtgat aataatctca ataacttgag tgagctatat tttctcttca 9780  
 gaatcttttg acatccaatg gtcgatgaaa gacaagcaat ggattctgta agaattaact 9840  
 gtaatgaaac taagtcttac ttattaagta gtctaagtaac attaaagggt gctttcattt 9900  
 atagaatcat aaaagggttt gtaaatacct acaacagatg gcccacctta aggaatgcta 9960  
 ttgtcctacc tctaagatgg ttaaactact ataaacttaa tacttatcca tctctacttg 10020  
 aatcacaga aaatgatttg attattttat caggattgag gtcttatcgt gagtttcatc 10080  
 tgccataaaa agtggatctt gaaatgataa taaatgacaa agccatttca cctccaaaag 10140  
 atctaatatg gactagtttt cctagaaatt acatgccatc acatatacaa aattatatag 10200  
 aacatgaaaa gttgaagtgc tctgaaagcg acagatcgag aagagtacta gagtattact 10260  
 tgagagataa taaattcaat gaatgcgatc tatacaattg tgtagtcaat caaagctatc 10320  
 tcaacaactc taatcacgtg gtatcactaa ctggttaaaga aagagagctc agtgtaggta 10380  
 gaatgtttgc tatgcaacca ggtatgttta ggcaaatcca aatcttagca gaaaaaatga 10440  
 tagctgaaaa tatttttaca ttcttcctcg agagtgtgac aagatatggg gatctagagc 10500  
 ttcaaaagat attagaatta aaagcaggaa taagcaacaa gtcaaatcgt tataatgata 10560  
 actacaacaa ttatatcagt aaatgttcta tcattacaga tcttagcaaa ttcaatcagg 10620  
 catttagata tgaacatca tgtatctgca gtgatgtatt agatgaactg catggagtac 10680  
 aatctctgtt ctcttggttg catttaacaa tacctcttgt cacaataata tgtacatata 10740  
 gacatgcacc tcctttcata aaggatcatg ttgttaatct taatgagggt gatgaacaaa 10800  
 gtggattata cagatatcat atgggtggta ttgagggtg gtgtcaaaaa ctgtggacca 10860  
 ttgaagctat atcattatta gatctaatat ctctcaagg gaaattctct atcacagctc 10920  
 tgataaatgg tgataatcag tcaattgata taagcaaac agttagactt atagagggtc 10980  
 agacccatgc acaagcagat tatttggttag cattaaatag ccttaaattg ttatataaag 11040  
 agtatgcagg tataggccat aagcttaagg gaacagagac ctatatatcc cgagatatgc 11100  
 agttcatgag caaaacaatc cagcacaatg gagtgtacta tccagccagt atcaaaaaag 11160  
 tcctgagagt aggtccatgg ataaacacga tacttgatga ttttaaagtt agtttagaat 11220  
 ctataggcag cttaacacag gagttagaat acagaggaga aagcttatta tgcagtttaa 11280  
 tatttaggaa catttggtta tacaatcaaa ttgctttgca actccgaaat catgcattat 11340  
 gtaacaataa gctatattta gatataatga aagtattaaa acacttaaaa acttttttta 11400  
 atcttgatag cattgatatg gctttatcat tgtatatgaa ttgcctatg ctgtttggtg 11460  
 gtggtgatcc taatttggtta tatcgaagct tttataggag aactccagac ttccttacag 11520  
 aagctatagt acattcagtg tttgtgttga gctattatac tggtcacgat ttacaagata 11580  
 agctccagga tcttcagat gatagactga acaattctt gacatgtgtc atcacatttg 11640  
 ataaaaatcc caatgccgag tttgtaacat tgatgaggga tccacaggct ttagggctg 11700  
 aaaggcaagc taaaattact agtgagatta atagattagc agtaacagaa gtcttaagta 11760  
 tagcccaaaa caaaatattt tctaaaagtg cacaacatta tactaccact gagattgatc 11820  
 taaatgacat tatgcaaaat atagaaccaa cttaccctca tggattaaga gttgtttatg 11880  
 aaagtttacc tttttataaa gcagaaaaaa tagttaatct tatatcagga acaaaatcca 11940

taactaatat acttgaaaa acatcagcaa tagatacaac tgatattaat agggctactg 12000  
 atatgatgag gaaaaatata actttactta taaggatact tccactagat tgtaacaaag 12060  
 acaaaagaga gttattaagt ttagaaaatc ttagtataac tgaattaagc aagtatgtaa 12120  
 gagaaagatc ttggtcatta tccaatatag taggagtaac atcgccaagt attatgttca 12180  
 caatggacat taaatatata actagcacta tagccagtgg tataataata gaaaaatata 12240  
 atgttaatag tttaactcgt ggtgaaagag gaccaccaa gccatgggta ggctcatcca 12300  
 cgaggagaa aaaaacaatg ccagtgtaca acagacaagt tttaaccaa aagcaaagag 12360  
 accaaataga ttatttagca aaattagact gggatatatgc atccatagac aacaaagatg 12420  
 aattcatgga agaactgagt actggaacac ttggactgtc atatgaaaa gccaaaaagt 12480  
 tgttccaca atatctaagt gtcaattatt tacaccgttt aacagtcagt agtagaccat 12540  
 gtgaattccc tgcataata ccagcttata gaacaacaaa ttatcatttt gatactagtc 12600  
 ctatcaatca tgtattaaca gaaaagtatg gagatgaaga tatcgacatt gtgtttcaaa 12660  
 attgcataag ttttggctt agcctgatgt cggttgtgga acaattcaca aacatatgtc 12720  
 ctaatagaat tattctcata ccgaagctga atgagatata tttgatgaaa cctcctatat 12780  
 ttacaggaga tgttgatata atcaagttga agcaagtgt acaaaagcag cacatgttcc 12840  
 taccagataa aataagttta acccaatatg tagaattatt cttaagtaac aaagcactta 12900  
 aatctggatc tcacatcaac tctaatttaa tattagtaca taaaatgtct gattattttc 12960  
 ataattgctta tattttaagt actaatttag ctggacattg gattctgatt attcaactta 13020  
 tgaaagattc aaaaggtatt ttgaaaaag attggggaga ggggtacata actgatcata 13080  
 tgttcattaa ttgaaatgtt ttctttaatg ctataagac ttatttgcta tgttttcata 13140  
 aaggttatgg taaagcaaaa ttagaatgtg atatgaacac ttcagatctt ctttgtgttt 13200  
 tggagttaat agacagtagc tactggaaat ctatgtctaa agttttccta gaacaaaaag 13260  
 tcataaaata catagtcaat caagacacaa gtttgcgtag aataaaaggc tgtcacagtt 13320  
 ttaagttgtg gtttttaaaa cgcttaata atgctaaatt taccgtatgc cttgggttg 13380  
 ttaacataga ttatcaccca acacacatga aagctatatt atcttacata gatttagtta 13440  
 gaatggggtt aataaatgta gataaattaa ccattaataa taaaaacaaa ttcaatgatg 13500  
 aattttacac atcaaatctc ttttacatta gttataactt ttcagacaac actcatttgc 13560  
 taacaaaaca aataagaatt gctaattcag aattagaaga taattataac aaactatctc 13620  
 acccaacccc agaaacttta gaaaatatgt cattaattcc tgttaaaagt aataatagta 13680  
 acaaacctaa attttgata agtggaata ccgaatctat gatgatgtca acattctcta 13740  
 gtaaaatgca tattaatct tccactgtta ccacaagatt caattatagc aaacaagact 13800  
 tgtacaattt atttccaatt gttgtgatag acaagattat agatcattca ggtaatacag 13860  
 caaaatctaa ccaactttac accaccactt cacatcagac atcttttagta aggaatagtg 13920  
 catcacttta ttgcatgctt cttggcatc atgtcaatag atttaacttt gtatttagtt 13980  
 ccacaggatg caagatcagt atagagtata ttttaaaaga tcttaagatt aaggacccca 14040  
 gttgtatagc attcataggt gaaggagctg gtaacttatt attacgtacg gtagtagaac 14100  
 ttcatccaga cataagatac atttacagaa gtttaaaaga ttgcaatgat catagtttac 14160  
 ctattgaatt tctaagggtta tacaacgggc atataaacat agattatggg gagaatttaa 14220  
 ccattcctgc tacagatgca actaataaca ttcattgggc ttatttacat ataaaatttg 14280  
 cagaacctat tagcatcttt gtctgcatg ctgaattacc tgttacagcc aattggagta 14340  
 aaattataat tgaatggagt aagcatgtaa gaaagtcaa gtactgttct tctgtaaata 14400  
 gatgcatttt aattgcaaaa tatcatgctc aagatgacat tgatttcaa ttagataaca 14460  
 ttactatatt aaaaacttac gtgtgcctag gtagcaagtt aaaaggatct gaagtttact 14520  
 taatccttac aataggccct gcaaatatac ttctgtttt tgatgttgta caaatgcta 14580  
 aattgacact ttcaagaact aaaaatttca ttatgcctaa aaaaactgac aaggaatcta 14640  
 tcgatgcaaa tattaagaagc ttaatacctt tcctttgtta ccctataaca aaaaaggaa 14700  
 ttaagacttc attgtcaaaa ttgaagagt tagttaatgg agatatatta tcatattcta 14760  
 tagctggacg taatgaagta ttcagcaaca agcttataaa ccacaagcat atgaatatcc 14820

```

taaaatggct agatcatgtt ttaaatttta gatcagctga acttaattac aatcatttat 14880
acatgataga gtccacatat cttacttaa gtgaattgtt aaatagttta acaaccaatg 14940
agctcaagaa gctgattaaa ataacaggta gtgtgctata caaccttccc aacgaacagt 15000
agtttaaaat atcattaaca agtttggtca aatttagatg ctaacacatc attatattat 15060
agttattaaa aaatatacaa acttttcaat aatttagcat attgattcca aaattatcat 15120
tttagtctta aggggttaaa taaaagtcta aaactaaca ttatacatgt gcattcacao 15180
cacaacgaga cattagtttt tgacactttt tttctcgt 15218

```

<210> 10

<211> 15229

<212> DNA

<213> respiratory syncytial virus

<400> 10

```

acgcgaaaaa atgcgtacta caaacttgca cattcggaaa aaatggggca aataagaatt 60
tgataagtgc tatttaaatc taaccttttc aatcagaaat ggggtgcaat tcactgagca 120
tgataaaggt tagattacaa aatttatttg acaatgacga agtagcattg ttaaaaataa 180
catgttatac tgacaaatta attcttctga ccaatgcatt agccaaagca gtaatacata 240
caattaaatt aaacggcata gtttttatac atgttataac aagcagtga gtgtgccctg 300
acaacaatat tgtagtgaat tctaacttta caacaatgcc aatattacaa aacggaggat 360
acatatggga attgattgag ttgacacact gctctcaatc aaatgggtcta atggatgata 420
attgtgaaat caaattttct aaaagactaa gtgactcagt aatgactaat tatatgaatc 480
aaatatctga tttacttggg cttgatctca attcatgaat tatgtttagt ctaatttaat 540
agacatgtgt ttatcaccat tttagttaat ataaaacctc atcaaaggga aatggggcaa 600
ataaactcac ctaatcagtc aaacatgag cactacaaat gacaacacta ctatgcaaag 660
attgatgatc acagacatga gacccctgtc gatggaatca ataataacat ctctcaccaa 720
agaaatcata acacacaaat tcatatactt gataaacaat gaatgtattg taagaaaact 780
tgatgaaaga caagctacat ttacattctt agtcaattat gagatgaagc tattgcacaa 840
agtagggagt accaaataca agaaatacac tgaatataat acaaaatatg gcactttccc 900
catgcctata tttatcaatc atgacgggtt tctagaatgt attggcatta agcctacaaa 960
acacactcct ataatacata aatatgacct caaccogtaa attccaacaa aaaactaacc 1020
catccaaact aagctatttc tcaaacaaca gtgctcaaca gttaagaagg agctaatacca 1080
ttttagtaat taaaaataaa ggcagagcca ataacataaa ttggggcaca tacaagatg 1140
gctcttagca aagtcaagtt aaatgataca ttaaataagg atcagctgct gtcatccagc 1200
aaatacacta ttcaacgtag tacaggagat aatattgaca ctcccaatta tgatgtgcaa 1260
aaacacctaa acaaactatg tggatgcta ttaatcactg aagatgcaaa tcataaattc 1320
acaggattaa taggtatgtt atatgctatg tccagggttag gaagggaaga cactataaag 1380
atacttaaag atgctggata tcatgttaaa gctaattggag tagatataac aacatatcgt 1440
caagatataa acggaaagga aatgaaattc gaagtattaa cattatcaag cttgacatca 1500
gaaatacaag tcaatattga gatagaatct agaaagtcct acaaaaaaat gctaaaagag 1560
atggggagaag tggctccaga atataggtat gattctccag actgtgggat gataatactg 1620
tgtatagctg cacttgtaat aaccaagtta gcagcaggag atagatcagg tcttacagca 1680
gtaattagga gggcaaaca tgtcttaaaa aacgaaataa aacgctacaa gggcctcata 1740
ccaaaggata tagctaacag tttttatgaa gtgtttgaaa aacacctca tcttatagat 1800
gtttttgtgc actttggcat tgcacaatca tccacaagag ggggtagtag agttgaagga 1860
atctttgcag gattatttat gaatgcctat ggttcagggc aagtaatgct aagatgggga 1920
gttctagcca aatctgtaaa aaatatcatg ctaggacatg ctagtgtcca ggcagaaatg 1980
gaacaagttg tggaaagttt tgagtatgca cagaagttgg gaggagaagc tggattctac 2040

```

catatatattga acaatccaaa agcatcattg ctgtcattaa ctcaatttcc taactttctca 2100  
agtgtggtcc taggcaatgc agcagggtcta ggcataaatgg gagagtatag aggtacacca 2160  
agaaaccaag atctatatga tgcagccaaa gcatatgcag agcaactcaa agaaaaatgga 2220  
gtaataaact acagtgtatt agacttaaca gcagaagaat tggaagccat aaagcatcaa 2280  
ctcaacccca aagaagatga tgtagagctt taagttaaca aaaaatacgg ggcaataaag 2340  
tcaacatgga gaagtttgca cctgaatttc atggagaaga tgcaaacac aaagctacca 2400  
aattcctaga atcaataaag ggcaagtttg catcatccaa agatcctaag aagaaagata 2460  
gcataatatac tgttaactca atagatatag aagtaactaa agagagcccg ataactctg 2520  
gcaccaacat catcaatcca ataagtgaag ctgatagtac cccagaagct aaagccaact 2580  
acccaagaaa acccctagta agcttcaaag aagatctcac cccaagtgac aaccctttt 2640  
ctaagttgta caaagaaaca atagaacat ttgataacaa tgaagaagaa tctagctact 2700  
catatgaaga aataaatgat caaacaaatg acaacattac agcaagacta gatagaattg 2760  
atgaaaaatt aagtgaata ttaggaatgc tccatacatt agtagttgca agtgcaggac 2820  
ccacctcagc tcgcatgga ataagagatg ctatggttg tctaagagaa gaaatgtag 2880  
aaaaataaag agcgaagca ttaatgacca atgatagggt agaggctatg gcaagactta 2940  
ggaatgagga aagcgaaaa atggcaaaag acacctcaga tgaagtgtct cttaatccaa 3000  
cttccaaaaa attgagtaat ttgttggaag acaacgatag tgacaatgat ctatcacttg 3060  
atgatttttg atcagtgatc aactcactca gcaatcaaca acatcaatga aacagacatc 3120  
aatccattga atcaactgcc agactgaaca cacaacgctc catcagcaga actaccaacc 3180  
aatcaatcaa ccaattgatc aatcagcgac ctaacaaaat taacaatata gtaacaaaa 3240  
aagaacaaga tggggcaaat atggaaacat acgtgaacaa gcttcacgag ggctccacat 3300  
acacagcagc tgttcagtac aatgttctag aaaaagatga tgatcctgca tactaaciaa 3360  
tatgggtgcc tatgttccag tcatctgtgc cagcagactt gctcataaaa gaacttgcaa 3420  
gcatcaacat actagtgaag cagatctcca cgcccaaagg accttcaacta cgagtcacga 3480  
ttaactcaag aagtgtgtg ctggcaciaa tgcctagtag ttttatcata agtgcaaatg 3540  
tatcattaga tgaaagaagc aaattagcat atgatgtaac tacacctgt gaaatcaaag 3600  
catgcagtct aacatgctta aaagtaaaaa gtatgttaac tacagtcaa gatcttacc 3660  
tgaaacatt caatccact catgagatta ttgctctatg tgaatttgaa aatattatga 3720  
catcaaaaag agtaataata ccaacctatc taagatcaat tagtgtcaa aacaaggacc 3780  
tgaaactcact agaaaatata gcaaccaccg aattcaaaaa tgctatcacc aatgcgaaa 3840  
ttattcccta tgcaggatta gtattagtta tcacagttac tgacaataaa ggagcattca 3900  
aatatatcaa gccacagagt caatttatag tagatcttg ggctaccta gaaaaagaga 3960  
gcatatatta tgtgactaca aattggaagc atacagctac acgtttttca atcaaaccac 4020  
tagaggatta aacttaatta tcaacactaa atgacaggtc cacatatatc ttcaaactat 4080  
acattatatc caaacatcat gagcatttac actacacact tttaccatat aaatcaatct 4140  
cattttaaatt ccaaaattac ttccagctat catctgttag acctagagtg cgaataggta 4200  
aataaaacca aaatatggg taaatagaca ttagttagag ttcaatcaat ctcaacaacc 4260  
atztataccg ccaattcagt acatatata taaatctcaa aatgggaaat acatccatca 4320  
caatagaatt cacaagcaaa ttttggcctt attttact aatacatatg atcttaactc 4380  
taatctcttt actaattata atcattata tgattgcaat actaaataag ctaagtgaac 4440  
ataaaacatt ctgcaacaaa actcttgaa taggacagat gtatcaaatc aacacatagt 4500  
gttctacat tatgtgtgt caaattataa tcttgatat ataaacaaac aaatccaatc 4560  
ttctcagaga gtcatggtg cgcaaaacca cgccaacct catgatagca tagagttagt 4620  
atttaaaaat taacataatg atgaattatt ggtatgagat caggaacaac attggggcaa 4680  
atgcagccat gtccaagcac agaactcggc gactgcccg gactctagaa aggacctggg 4740  
atactcttaa tcatctaatt gtaatatct cttgtttata cagattaaat ttaaaatcta 4800  
tagcacaat agcactgtca gttttggcaa tgataatctc aacctctctc ataattgcag 4860  
ccataatatt catcatctct gccaatcaca aagttact aacaacggtt acagttcaaa 4920

caataaaaaa ccacttgaa aaaaacatct ccactacct tactcaagtc ccaccagaaa 4980  
 gggtcactc atccaaacaa cccacaacca catcaccaat ccacacaaat tcagccacaa 5040  
 tatcaccaaa tacaaaatca gaaacacacc atacaacagc acaaaccaaa ggcagaatca 5100  
 ccacttcaac acagaccaac aagccaagca caaatcacg ttcaaaaaat ccaccaaaaa 5160  
 aacaaaaaga tgattaccat tttgaagtgt tcaattttgt tccctgtagt atatgtggtg 5220  
 ataatacaact ctgcaaatcc atctgcaaaa caataccaag caacaaacca aagaaaaaac 5280  
 caaccatcaa acccacaac aaaccaacca ccaaaaccac aaacaaaaga gaccccaaaa 5340  
 caccagccaa atgccaacaa aaagaaatca tcaccaaccc agcaaaaaaa ccaaccctca 5400  
 agaccacaga aagagacacc agcatttcac aatccaccgt gctcgacaca atcactccaa 5460  
 aatacacaaat ccaacagcaa tccctccact caaccacctc cgaaaacaca cccagctcca 5520  
 cacaataacc cacagcatcc gagccctcca cattaaatcc taattaaaaa acctagtcc 5580  
 atgcttagtt attcaaaaac tacatcttag cagagaaccg tgatctatca agcaagaaca 5640  
 aaattaaacc tggggcaaat aaccatggag ttgctgatcc acaggtcaag tgcaatcttc 5700  
 ctaactcttg ctgttaatgc attgtacctc acctcaagtc agaacataac tgaggagttt 5760  
 taccaatcga catgtagtgc agttagcaga gggtatttta gtgctttaag aacagggttg 5820  
 tataccagtg tcataacaat agaattaagt aatataaaag aaaccaaatg caatggaaact 5880  
 gacactaaag taaaacttat aaaacaagaa ttagataagt ataagaatgc agtaacagaa 5940  
 ttacagctac ttatgcaaaa cagccagct gccacaacc gggccagaag agaagcacca 6000  
 cagtacatga actacacaat caataccaca aaaaacctaa atgtatcaat aagcaagaaa 6060  
 aggaaacgaa gatttctggg cttctgtgta ggtgtaggat ctgcaatagc aagtgtgata 6120  
 gctgtatcca aagttttaca ccttgaagga gaagtgaaca aaatcaaaaa tgctttgttg 6180  
 tctacaaca aagctgtagt cagtctatca aatggggtca gtgttttaac cagcaaatg 6240  
 ttagatctca agaattacat aaataaccga atattacca tagtaaatca acagagctgt 6300  
 cgcctctcca acattgaaac agttatagaa ttccagcaga agaatagcag attgttgga 6360  
 atcaccagag aatttagtgt taatgcaggt gtaacaacac ctttaagcac ttacatgta 6420  
 acaaacagtg agttactatc attgatcaat gatatgccta taacaaatga ccagaaaaa 6480  
 ttaatgtcaa gcaatgttca gatagtaagg caacaaagtt attctatcat gtctataata 6540  
 aaggaagaag tccttgcata tgtgtacag ctacctatct atgggtgtaat agatacacct 6600  
 tgctggaaat tacacacatc acctctatgc accaccaaca tcaaagaagg atcaaatatt 6660  
 tgtttaacaa ggactgatag aggatggtat tgtgataatg caggatcagt atcctcttc 6720  
 ccacaggctg atacttgcaa agtacagtcc aatcgagtat tttgtgacac tatgaacagt 6780  
 ttaacattac caagtgaagt cagcctttgt aacactgaca tattcaattc caagtatgac 6840  
 tgcaaaatta tgacatcaaa aacagacata agcagctcag taattacttc tcttgagct 6900  
 atagtgtcat gctatggaaa aactaaatgc actgcatcca ataaaaatcg tgggattata 6960  
 aagacatttt ctaatggttg tgactatgtg tcaaacaaag gagtagatac tgtgtcagtg 7020  
 ggcaacactt tatactatgt aaacaagctg gaaggcaaaa acctttatgt aaaaggggaa 7080  
 cctataataa attactatga tcctctagtgt tttccttctg atgagtttga tgcatcaata 7140  
 tctcaagtca atgaaaaaat caatcaaagt ttagctttta ttcgtagatc tgatgaatta 7200  
 ctacataatg taaatactgg caaatctact acaaatatta tgataactac aattattata 7260  
 gtaatcattg tagtattgtt atcattaata gctattggtt tactgttgta ttgcaaagcc 7320  
 aaaaacacac cagttactac aagcaaagac caactaagtg gaatcaataa tattgcattc 7380  
 agcaaataga caaaaaacta cttaatcatg tttcaacaac aatctgctga ccaccaatcc 7440  
 caaatcaact taacaacaaa tatttcaaca tcatagcaca ggctgaatca tttcctcata 7500  
 tcatgtacc tacacaacta agctagatct tcaactcata gttacataaa aaccccaagt 7560  
 atcacaatca aacactaaat cgacacatca ttcacaaaat taacaactgg ggcaaatatg 7620  
 tcgcgaagaa atccttgtaa atttgagatt agaggtcatt gcttgaatgg tagaagatgt 7680  
 cactacagtc ataattattt tgaatggcct cctcatgcat tactagttag gcaaaacttc 7740  
 atgttaaaaa agatacttaa gtcaatggac aaaagcatag acactttgtc ggaaataagt 7800



ggagctgctg aactggatag aacagaagaa tatgctcttg gtatagttgg agtgctagag 7860  
 agttacatag gatcaataaa caacataaca aaacaatcag catgtgttgc tatgagtaaa 7920  
 cttcttattg agatcaacag tgatgacatt aaaaaactga gagataacga agaacccaat 7980  
 tcgcctaaga taagagtgtg caatactggt atatcataca ttgagagcaa tagaaaaaac 8040  
 aacaagcaaa ccatccatct gctcaaaaga ctaccagcag acgtgctgaa gaagacaata 8100  
 aagaacacat tagatatcca caaaagcata accataagca actcaaaaga gtcaaccgtg 8160  
 aatgatcaaa atgaccaaac caaaaataat gatattaccg gataaatatc cttgtagtat 8220  
 atcatccata ttgattttcaa gtgaaagcat gattgctaca ttcaatcata aaaacatatt 8280  
 acaatttaac cataaccatt tggataacca ccagtgttta ttaaatacata tatttgatga 8340  
 aattcattgg acacctaaaa acttattaga tgccactcaa caatttctcc aacatcttaa 8400  
 catccctgaa gatatatata cagtatatat attagtgtca taatgcttga ccataacaat 8460  
 tttatatcat tcaaccataa aacaacctta ataaggttat gggacaaaat ggatcccat 8520  
 attaatggaa actctgccaa tgtgtatcta actgatagtt atctaaaagg tgttatctct 8580  
 ttttcagaat gtaatgcttt agggagttac ctttttaacg gccctatct taaaaatgat 8640  
 tacaccaact taattagtag acaaagccca ctactagagc atatgaatct aaaaaacta 8700  
 actataacac agtcattaat atctagatat cataaagggtg aactgaagtt agaagaacca 8760  
 acttatttcc agtcattact tatgacatat aaaagtatgt cctcgtctga acaaatgtct 8820  
 acaactaatt tacttaaaaa aataatacga agagctatag aaataagtga tgtaaagggtg 8880  
 tacgccatct tgaataaact gggactaaag gaaaaggaca gagttaagcc caacaataat 8940  
 tcaggtgatg aaaactcagt tcttacaacc ataatcaaag atgatatact ttcagctgtg 9000  
 gaaaacaatc aatcatatac aaattcagac aaaaatcatt cagttaatca aaatatcact 9060  
 atcaaaacaa cactcttgaa aaaattgatg tgttcaatgc aacatcctcc atcatggtta 9120  
 atacactggg tcaattttata taaaaatta aataacatat taacacaata tcgatcaaat 9180  
 gaggtaaaaa gtcatgggtt tatattaata gataatcaaa ctttaagtga ttttcagttt 9240  
 attttaaatc aatatgggtt tatcgtttat cataaaggac tcaaaaaaat cacaactact 9300  
 acttacaatc aatttttgac atggaaagac atcagcctta gcagattaaa tgtttgctta 9360  
 attacttgga taagtaattg tttaataaca ttaataaaaa gcttagggct gagatgtgga 9420  
 ttcaataatg ttgtgttata acaactattt ctttatggag attgtatact gaaattattc 9480  
 cataatgaag gcttctacat aataaaagaa gtagagggtt ttattatgtc tttaattcta 9540  
 aacataacag aagaagatca atttaggaaa cgattttata atagcatgct aaataacatc 9600  
 acagatgcag ctattaaggc tcaaaaaaac ctactatcaa gagtatgtca cactttatta 9660  
 gacaagacag tgtctgataa tatcataaat ggtaaagtga taatcctatt aagtaatttt 9720  
 cttaaattga ttaagcttgc aggtgataat aatctcaata acttgagtga gctttatttt 9780  
 ctcttcagaa tctttggaca tccaatggtc gatgaaagac aagcaatgga tgctgtaaga 9840  
 attaactgta atgaaaccaa gttctactta ttaagtaatc taagtacgtt aagagggtgct 9900  
 ttcattttata gaatcataaa ggggtttgta aataacctaca acagatggcc cactttaagg 9960  
 aatgctattg ttctacctct aagatgggtt aactattata aacttaatac ttatccatct 10020  
 ctacttgaaa tcacagagaa agatttgatt attttatcag gattgcggtt ctatcgtgag 10080  
 tttcatctgc ctaaaaaagt ggatcttgaa atgataataa atgacaaagc catttcacct 10140  
 ccaaagatt taatatggac tagttttcct agaaattaca tgccatcaca tacaacaaat 10200  
 tatatagaac atgaaaagt gaagttctct gaaagtgaac gatcaagaag agtactagag 10260  
 tattacttga gagataataa attcaatgaa tgcgatctat acaattgtgt ggtcaatcaa 10320  
 agctatctca acaactctaa ccatgtggta tcaactaactg gtaaagaaag agagctcagt 10380  
 gtaggtagaa tgtttgctat gcaaccaggt atgttttaggc aaattcaaat ctagcagag 10440  
 aaaatgatag ccgaaaatat ttacaattc ttccctgaga gtttgacaag atatggtgat 10500  
 ctagagcttc aaaagatatt agaattaaaa gcaggaataa gcaacaagtc aaatcgttat 10560  
 aatgataact acaacaatta tatcagtaaa tgttctatca ttacagacct tagcaaatc 10620  
 aatcaagcat ttagatatga aacatcatgt atctgcagtg atgtattaga tgaactgcat 10680

ggagtacaat ctctgttctc ttggttgcac ttaacaatac ctcttgtcac aataatatgt 10740  
 acatatagac atgcacctcc ttttataaag gatcatgttg ttaatcttaa taaagttgat 10800  
 gaacaaagtg gattatacag atatcatatg ggtggtattg aaggctggtg tcaaaaactg 10860  
 tggaccattg aagctatatac attattagat ctaatatctc tcaaagggaa attctctatc 10920  
 acagctctaa taaatggtga taatcagtca attgatataa gtaaaccagt tagacttata 10980  
 gagggtcaga cccatgctca agcagattat ttgttagcat taaatagcct taaattgcta 11040  
 tataaagagt atgcgggcat aggccacaag ctcaagggaa cagagacctc tatatcccg 11100  
 gatatgcaat tcatgagcaa aacaatccag cacaatggag tgtactatcc agccagtatc 11160  
 aaaaaagtcc tgagagtagg tccatggata aatacaatac ttgatgattt taaagttagt 11220  
 ttagaatcta taggtagctt aacacaggag ttagaatata gaggagagag cttattatgc 11280  
 agtttaatat ttaggaacat ttggttatac aatcaaattg ctttgcaact ccgaaatcat 11340  
 gcattatgtc acaataagct atatttagat atattgaaag tattaataca cttaaaaact 11400  
 ttttttaatc ttgatagtat tgatatggct ttaacattgt atatgaattt gcctatgctg 11460  
 tttggtggtg gtgatcctaa tttgttatat cgaagctttt ataggagaac tccagacttc 11520  
 cttacagaag ctatagtaca ttcagtgttt gtgttgagct attatactgg tcacgattta 11580  
 caagataagc tccaggatct tccagatgat agactgaaca aattcttgac atgtatcatc 11640  
 acgtttgata aaaatcccaa tgccgagttt gtaacattga tgagagatcc acaggcttta 11700  
 ggggtctgaaa ggcaagcaaa aattactagt gagattaata gattagcagt gacagaagtc 11760  
 ttaagtatag ctccaaacaa aatattttct aaaagtgcac aacattatac taccactgag 11820  
 attgatctaa atgatattat gcaaaatata gaaccaactt accctcatgg attaagagtt 11880  
 gtttatgaaa gtttaccttt ttataaagca gaaaaaatag ttaatcttat atcaggaaca 11940  
 aaatccataa ctaataact tgaaaaaca tcagcaatag attcaactga tattaatagg 12000  
 gctactgata tgatgaggaa aaatataact ttacttataa ggatacttcc actagattgt 12060  
 aacaaagaca aaagagagtt attaagttaa gaaaatctta gtataactga attaaagcaag 12120  
 tatgtaagag aaagatcttg gtcgttatcc aatatagtag gagtaacatc gccaaagtatt 12180  
 atgttcacaa tggacattaa atatacaact agcactatag ccagtgggtat aattatagaa 12240  
 aaatataatg ttaatagttt aactcgtggt gaaagaggac ctactaagcc atgggtaggt 12300  
 tcatctacgc aggagaaaaa aacaatgcca gtgtacaata gacaagtttt aaccaaaaag 12360  
 caaagagacc aaatagattt attagcaaaa ttagactggg tatatgcac catagacaac 12420  
 aaagatgaat tcatggaaga actgagtact ggaacacttg gactgtcata tgagaaagcc 12480  
 aaaaaattgt ttccacaata tctaagtgtc aattatttac accgcttaac agtcagtagt 12540  
 agaccatgtg aattccctgc atcaatacca gcttatagaa caacaaatta tcatttcgat 12600  
 actagtccta tcaaccatgt attaacagaa aagtatggag atgaagatat cgacattgtg 12660  
 tttcaaaatt gcataagttt tggctcttagc ttaatgtcgg ttgtggaaca attcacaac 12720  
 atatgtccta atagaattat tctcataccg aagctgaatg agatacattt gatgaaacct 12780  
 cctatattta caggagatgt tgatatcatc aagttgaagc aagtgtaca aaaacagcac 12840  
 atgttcctac cagataaaat aagtttaacc caatatgtag aattattcct aagtaacaaa 12900  
 gcacttaaat ctggatctca catcaactct aatttaatat tagtacataa aatgtctgat 12960  
 tattttcata atgcttatat ttttaagtact aatttagctg gacattggat tctgattatt 13020  
 caacttatga aggattcaaa aggtattttt gaaaaagatt ggggagaggg gtatataact 13080  
 gatcatatgt tcattaattt gaatgttttc tttaatgctt ataagactta tttgctatgt 13140  
 tttcataaag gttatggtaa agcaaaatta gaatgtgata tgaacacttc agatcttctt 13200  
 tgtgttttgg agctaataga cagtagctac tggaaatcta tgtctaaagt tttcctagaa 13260  
 caaaaagtca taaaatacat aatcaatcaa gacacaagtt tgcatagaat aaaaggttgt 13320  
 catagtttta agttatgggt tttaaaacgc cttaataatg ctaaatttac cgtatgccct 13380  
 tgggttggtta acatagatta tcaccaaca cacatgaaag ctatattatc ttacatagat 13440  
 ttagttagaa tggggttaat aaatgtagat aaattaacca ttaaaaataa aaataaatc 13500  
 aatgatgaat tttacacatc aaatctcttt tacattagtt ataacttttc agataacact 13560

```

catttgctaa caaaacaaat aagaattgct aattcagaat tagaaaataa ttataacaaa 13620
ctatatcacc caaccccgaga aacttttagaa aatatgtcat taattcctgt caaaagtaat 13680
aatagtaata aacctaaatt tgggtataagt ggaaataccg aatctatgat gacgtcaaca 13740
ttctccaata aaacgcatat taaatcttcc gctgttatta caagattcaa ttatagtaaa 13800
caagacttgt acaattttatt tccaattgtc gtgatagaca ggattataga tcattcaggt 13860
aatacagcaa aatctaacca actctacact accacttcac atcagacatc tttagtaagg 13920
aatagtgcac cactttattg catgcttctc tggcatcatg tcaatagatt taactttgta 13980
tttagttcca caggatgcaa gatcagtata gagtatattt taaaagatct taagattaaa 14040
gaccccgatt gtatagcatt cataggtgaa ggagctggta acttattatt acgtacagta 14100
gtagaacttc atccagacat aagatacatt tacagaagtt taaaagattg caatgatcat 14160
agttttacct ttgaatttct aagggttatac aacgggcata taaacataga ttatggtgag 14220
aatttaacca ttcttgctac agatgcaact aataacattc attggtctta tttacatata 14280
aaatttgtag aacctattag catttttgtc tgcgatgctg aattacctgt tacagccaat 14340
tggagtaaaa ttataattga atggagtaag catgtaagaa agtgcaagta ctgttcctct 14400
gtaaatagat gcatttttaat tgcaaaatat catgcccaag atgatattga tttcaaatta 14460
gataacatta ctatattaaa aacttacgtg tgcctaggta gcaagttaaa aggatctgaa 14520
gtttacttag tccttacaat aggccttgca aatatacttc ctgtttttta tgttggtgaa 14580
aatgctaaat tgattctttc aaggactaaa aatttcatta tgcctaaaaa aactgacaaa 14640
gaatctatcg atgcaaatat taaaagctta atacctttcc tttgttacc tataacaaaa 14700
aaaggaatta agacttcatt gtcaaaattg aagagtgtag ttagtggaga tatattatca 14760
tattctatag ctggacgtaa tgaagtattc agcaacaagc ttataaacca caagcatatg 14820
aatatcctaa aatggctaga tcatgtttta aacttttagat cagctgaact taattacaat 14880
catttatata tgatagagtc cacatatcct tacttaagtg aattgttaaa cagttaaca 14940
accaatgagc tcaagaagct gattaaaata acaggtagtg tactatacaa ccttccaac 15000
gaacagtaac ttaaaacatc attaacaagt ttgatcaaat ttagatgcta acacatcata 15060
atattatagt tattaataaaa tatatatgca aacttttcaa taatttagca tattgattcc 15120
aaagttatca ttttggtctt aaggggttga ataaaaatct aaaactaaca attatacatg 15180
tgcatttaca acacaacgag acattagttt ttgacacttt ttttctcgt 15229

```

<210> 11

<211> 15219

<212> DNA

<213> respiratory syncytial virus

<400> 11

```

acgggaaaaa aatgcgtact acaaacttgc acattcgaaa aaaatggggc aaataagaac 60
ttgataagtg ctatttaagt ctaacctttt caatcagaaa tggggtgcaa ttactgagc 120
atgataaagg ttagattaca aaatttattt gacaatgacg aagtagcatt gttaaaaata 180
acatgttata ctgataaatt aattcttctg accaatgcat tagccaaagc agcaatacat 240
acaattaaat taaacggcat agtttttata catgttataa caagcagtga agtgtgccct 300
gataacaata ttgtagtga atctaacttt acaacaatgc caatactaca aaatggagga 360
tacatatggg aattgattga gttgacacac tgctctcaat taaacggttt aatggatgat 420
aattgtgaaa tcaaattttc taaaagacta agtgactcag taatgactaa ttatatgaat 480
caaatatctg acttacttgg gcttgatctc aattcatgaa ttatgttttag tctaattcaa 540
tagacatgtg tttattacca ttttagttaa tataaaaact catcaaaggg aaatggggca 600
aataaactca cctaatacat caaacatga gcactacaaa tgacaacact actatgcaaa 660
gattgatgat cacagacatg agaccctgt caatggatc aataataaca tctcttacca 720
aagaaatcat cacacacaaa ttcataact tgataaacia tgaatgtatt gtaagaaaac 780

```

```

ttgatgaaag acaagctaca tttacattct tagtcaatta tgagatgaag ctactgcaca 840
aagtagggag taccaaatac aaaaaataca ctgaatataa tacaaaatat ggcactttcc 900
ccatgcctat atttatcaat cacggcgggt ttctagaatg tattggcatt aagcctacaa 960
aacacactcc tataatatac aaatatgacc tcaaccctg aattccaaca aaaaaacca 1020
cccaaccaa ccaaactatt cctcaaaca caagtgtcaa tagttaagaa ggagctaata 1080
catttttagta attaaaaata aaagtaaagc caataacata aattggggca aatacaaga 1140
tggctcttag caaagtcaag ttgaatgata cattaataa ggatcagctg ctgtcatcca 1200
gcaaatacac tattcaacgt agtacaggag ataatttga cactccaat tatgatgtgc 1260
aaaaacacct aaacaaacta tgtggtatgc tattaatcac tgaagatgca aatcataaat 1320
tcacaggatt aataggtatg ttatatgcta tgtccagggt aggaaggga gacactataa 1380
agatacttaa agatgctgga tatcatgtta aagctaattg agtagatata acaacataatc 1440
gtcaagatat aaatggaaag gaaatgaaat tcgaagtatt aacattatca agcttgacat 1500
cagaaataca agtcaatatt gagatagaat ctagaaagtc ctacaaaaaa atgctaaaag 1560
agatgggaga agtggctcca gaatataggt atgattctcc agactgtggg atgataatac 1620
tgtgtatagc tgcacttgtg ataaccaaat tagcagcagg agacagatca ggtcttacag 1680
cagtaattag gagggcaaac aatgtcttaa aaaacgaaat aaaacgatac aagggcctca 1740
taccaaagga tatagctaac agtttttatg aagtgtttga aaaacacct catcttatag 1800
atgttttctg gcactttggc attgcacaat catccacaag aggggtagt agagttgaag 1860
gaatccttgc aggtattgtt atgaatgcct atggttcagg gcaagtaatg ctaagatggg 1920
gagtttttagc caaatctgta aaaaatatca tgctaggaca tgctagtgtc caggcagaaa 1980
tggagcaagt tgtggaagtc tatgagtatg cacagaagtt gggaggagaa gctggattct 2040
accatataat gaacaatcca aaagcatcat tgctgtcatt aactcaattt cccaacttct 2100
caagtgtggt cctaggcaat gcagcaggtc taggcataat gggagagtat agaggtacac 2160
caagaaacca ggatctttat gatgcagcta aagcatatgc agagcaactc aaagaaaatg 2220
gagtaataaa ctacagtgtg ttagacttaa cagcagaaga attggaagcc ataaagcatc 2280
aactcaacc caaagaagat gatgtagagc ttaaagttaa caaaaaatac ggggcaata 2340
agtcaacatg gagaagttt cacctgaatt tcatggagaa gatgcaata acaaagctac 2400
caaattccta gaatcaataa agggcaagtt cgcacatcc aaagatccta agaagaaaga 2460
tagcataata tctgttaact caatagatat agaagtaact aaagagagcc cgataacatc 2520
tggcaccaac atcatcaatc caacaagtga agccgacagt accccagaaa caaaagccaa 2580
ctacccaaga aaacccttag taagcttcaa agaagatctc accccaagtg acaaccctt 2640
ttctaagttg tacaaggaaa caatagaaac atttgataac aatgaagaag aatctagcta 2700
ctcatatgaa gagataaatg atcaaacaaa tgacaacatt acagcaagac tagatagaat 2760
tgatgaaaaa ttaagtgaat tattaggaat gctccataca ttagtagttg caagtgcagg 2820
accacttca gctcgcgatg gaataagaga tgctatgggt ggtctaagag aagagatgat 2880
agaaaaata agagcggaag cattaatgac caatgatagg ttagaggcta tggcaagact 2940
taggaatgag gaaagcgaaa aaatggcaaa agacacctca gatgaagtgt ctcttaatcc 3000
aacttccaaa aaattgagtg acttggttga agacaacgat agtgacaatg atctatcact 3060
tgatgatttt tgatcagcga tcaactcact cagcaatcaa caacatcaat aaaacagaca 3120
tcaatccatt gaatcaactg ccagaccgaa caaacaaacg tccatcagta gaaccacca 3180
ccaatcaatc aaccaattga tcaatcagca acccgacaaa attaacaata tagtaacaaa 3240
aaaagaacaa gatggggcaa atatggaaac atacgtgaac aagcttcacg aaggctccac 3300
atacacagca gctgttcagt acaatgttct agaaaaagat gatgatcctg catcactaac 3360
aatatgggtg cctatgttcc agtcatctgt gccagcagac ttgctcataa aagaacttgc 3420
aagcatcaat atactagtga agcagatctc tacgcccacaa ggaccttcac tacgagtcac 3480
gattaactca agaagtgtg tgctggctca aatgcctagt aatttcatca taagcgcaaa 3540
tgtatcatta gatgaaagaa gcaaattagc atatgatgta actacacctt gtgaaatcaa 3600
agcatgcagt ctaacatgct taaaagtaaa aagtatgtta actacagtc aagatcttac 3660

```

```

catgaagaca ttcaacccca ctcatgagat cattgctcta tgtgaatttg aaaatattat 3720
gacatcaaaa agagtaataa taccaacctt tctaagatca attagtgtca agaacaagga 3780
tctgaactca ctagaaaata tagcaaccac cgaattcaaa aatgctatca ccaatgcaaa 3840
aattattcct tatgcaggat tagtgttagt tatcacagtt actgacaata aaggagcatt 3900
caaatatata aaaccacaga gtcaatttat agtagatctt ggtgcctacc tagaaaaaga 3960
gagcatatat tatgtgacta ctaattggaa gcatacagct acacgttttt caatcaaacc 4020
actagaggat taaacttaat tatcaacact gaatgacagg tccacatata tcctcaaact 4080
acacactata tccaaacatc ataaacatct acactacaca cttcatcaca caaaccaatc 4140
ccactcaaaa tccaaaatca ctaccagcca ctatccgcta gacctagagt gcgaataggc 4200
aaataaaacc aaaatatggg gtaaatagac attagttaga gttcaatcaa tcttaacaac 4260
cattttatacc gccaatccaa cacatatact ataaatctta aaatgggaaa tacatccatc 4320
acaatagaac tcacaagcaa attttgcccc tattttacac taatacatat gatcttaact 4380
ctaactcttt tactaattat aatcactatc atgattgcaa cactaaataa gctaagtga 4440
caciaagcat tctgcaacaa aactcttgaa ctaggacaga tgtaccaaat caacacacag 4500
agttccacca ttatgctgtg tcaaaccata atcctgtata tacaacaaa caaatccaat 4560
cctctcacag agtcacgggt tcgcaaaacc acgctaacca tcatggtagc atagagtagt 4620
tatttaaaaa ttaacataat gatgaattgt tagtatgaga tcaaaaacaa cattggggca 4680
aatgcaacca tgtccaaaca caagaatcaa cgcactgcca ggactctaga aaagacctgg 4740
gatactctta atcatcta atgtaatatcc tcttgtttat acagattaaa tttaaaatct 4800
atagcacaaa tagcactatc agttttggca atgataatct caacctctct cataattgca 4860
gccataatat tcatcatctc tgccaatcac aaagttacac taacaacggg cacagtcaa 4920
acaataaaaa accacactga aaaaaacatc accacctacc ctactcaagt ctaccagaa 4980
aggggttagt catccaagca acccacaacc acatcaccaa tccacacaag ttcagctaca 5040
acatcaccca atacaaaatc agaaacacac catacaacag caciaaacaa aggcagaacc 5100
accacttcaa cacagacca caagccaagc acaaaaccac gtccaaaaaa tccacaaaa 5160
aaagatgatt accattttga agtggtcaac ttcgttccct gcagtatatg tggcaacaat 5220
caactttgca aatccatctg caaaacaata ccaagcaaca aaccaagaa gaaaccaacc 5280
atcaaaccca caaacaaacc aaccacaaa accacaaaca aaagagaccc aaaaacacca 5340
gccaaaacga cgaaaaaaga aactaccacc aaccacaaca aaaaactaac cctcaagacc 5400
acagaaagag acaccagcac ctcaaatcc actgcactcg acacaaccac attaaaacac 5460
acagtccaac agcaatccct cctctcaacc accccgaaa acacacccaa ctccacacaa 5520
acaccacag catccgagcc ctccacacca aactccaccc aaaaaacca gccacatgct 5580
tagttattca aaaactacat cttagcagag aaccgtgatc tatcaagcaa gaacgaaatt 5640
aaacctgggg caaataacca tggagttgat gatccacaag tcaagtgcaa tcttcctaac 5700
tcttgctatt aatgcattgt acctcacctc aagtcagaac ataactgagg agttttacca 5760
atcgacatgt agtgcagtta gcagagggtta ttttagtgct ttaagaacag gttggtatac 5820
tagtgtcata acaatagaat taagtaatat aaaagaaacc aaatgcaatg gaactgacac 5880
taaagtaaaa cttatgaaac agaattaga taagtataag aatgcagtaa cagaattaca 5940
gctacttatg caaaacacac cagctgtcaa caaccgggcc agaagagaag caccacagta 6000
tatgaactac acaatcaata ccactaaaaa cctaaatgta tcaataagca agaagaggaa 6060
acgaagatct ctaggcttct tgtaggtgt gggatctgca atagcaagtg gtatagctgt 6120
atcaaaagtt ctacaccttg aaggagaagt gaacaagatc aaaaatgctt tgttgtctac 6180
aaacaaagct gtagtcagtt tatcaaatgg ggtcagtggt ttaaccagca aagtgttaga 6240
tctcaagaat tacataaata accaattatt acccatagta aatcaacaga gctgtcgcat 6300
ctccaacatt gaaacagtta tagaattcca gcagaagaac agcagattgt tggaaatcac 6360
cagagaatct agtgtcaatg caggtgtaac aacaccttta agcacttaca tgttgacaaa 6420
cagtgagttta ctatcattaa tcaatgatat gcctataaca aatgatcaga aaaaattaat 6480
gtcaagcaat gttcagatag taaggcaaca aagttattcc atcatgtcta taataaagga 6540

```

```

agaagtcctt gcatatgttg tacagctgcc tatctatggt gtaatagata caccttgctg 6600
gaaattgcac acatcgcttc tatgcactac caacatcaaa gaaggatcaa atatttgttt 6660
aacaaggact gatagaggat ggtattgtga taatgcagga tcagtatcct tctttccaca 6720
ggctgacact tgtaaagtac agtccaatcg agtattttgt gacactatga acagtttgac 6780
attaccaagt gaagtcagcc tttgtaacac tgacatattc aattccaagt atgactgcaa 6840
aattatgaca tcaaaaacag acataagcag ctgagtaatt acttctcttg gagctatagt 6900
gtcatgctat ggtaaaacta aatgcactgc atccaacaaa aatcgtggga ttataaagac 6960
atthttcta atgtgtgact atgtgtcaaa caaaggagta gatactgtgt cagtgggcaa 7020
cactttatac tatgtaaaac agctggaagg caagaacctt tatgtaaaag gggaacctat 7080
aataaattac tatgaccttc tagtgtttcc ttctgatgag tttgatgcat caatatctca 7140
agtcaatgaa aaaatcaatc aaagtttagc ttttattcgt agatctgatg aattactaca 7200
taatgtaaat actggcaaat ctactacaaa tattatgata actacaatta ttatagtaat 7260
cattgtagta ttgttatcat taatagctat tgggttactg ttgtattgta aagccaaaaa 7320
cacaccagtt aactaagca aagaccaact aagtggaaac aataatattg cattcagcaa 7380
atagacaaaa aaccacctga tcatgtttca acaacaatct gctgaccacc aatcccaaat 7440
caacttaca caaatatttc aacatcacag tacaggctga atcatttctt cacatcatgc 7500
taccacata actaagctag atccttaact tatagttaca taaaaacctc aagtatcaca 7560
atcaaccact aaatcaacac atcattcaca aaattaacag ctggggcaca tatgtcgcga 7620
agaaatcctt gtaaatttga gattagaggt cattgcttga atggtagaag atgtcactac 7680
agtcataatt actttgaatg gcctcctcat gcattactag tgaggcaaaa cttcatgtta 7740
aacaagatac tcaagtcaat ggacaaaagc atagacactt tgtctgaaat aagtggagct 7800
gctgaactgg atagaacaga agaatatgct cttggtatag ttggagtgtt agagagttac 7860
ataggatcta taaacaacat aacaaaaaaa tcagcatgtg ttgctatgag taaacttctt 7920
attgagatca atagtgatga cattaaaaag cttagagata atgaagaacc caattcacct 7980
aagataagag tgtacaatac tgttatatca tacattgaga gcaatagaaa aaacaacaag 8040
caaaccatcc atctgctcaa gagactacca gcagacgtgc tgaagaagac aataaagaac 8100
acattagata tccacaaaag cataaccata agcaatccaa aagagtcaac tgtgaatgat 8160
caaatgacc aaaccaaaaa taatgatatt accggataaa tatccttgta gtatatcatc 8220
catattgatc tcaagtgaat gcattggttc tacattcaat cataaaaaa tattacaatt 8280
taaccataac tatttgata accaccagcg tttattaaat catatatttg atgaaattca 8340
ttggacacct aaaaacttat tagatgccac tcaacaattt ctccaacatc ttaacatccc 8400
tgaagatata tatacagtat atatataggt gtcataatgc ttgaccataa cgactctatg 8460
tcatccaacc ataaaactat tttgataagg ttatgggaca aaatggatcc cattattaat 8520
ggaaactctg ctaatgtgta tctaactgat agttatttaa aaggtgttat ctctttttca 8580
gagtgtaatg ctttagggag ttatcttttt aacggccctt atcttaaaaa tgattacacc 8640
aacttaatta gtagacaaa cccactacta gagcatatga atcttaaaaa actaactata 8700
acacagtcac taatatctag atatcataaa ggtgaactga aattagaaga accaacttat 8760
ttccagtcac tacttatgac atataaaagt atgtcctcgt ctgaacaaat tgctacaact 8820
aacttactta aaaaaataat acgaagagcc atagaaataa gtgatgtaa ggtgtacgcc 8880
atcttgaata aactaggatt aaaggaaaag gacagagtta agccaacaa taattcaggt 8940
gatgaaaact cagtacttac aaccataatt aaagatgata tactttcggc tgtggaaaaa 9000
aatcaatcat atacaaattc agacaaaagt cactcagtaa atcaaaatat cactatcaaa 9060
acaacactct tgaaaaaatt gatgtgttca atgcaacatc ctccatcatg gttataacac 9120
tggttcaatt tatatacaaa attaaataac atattaacac aatatcgatc aaatgaggta 9180
aaaagtcatg ggtttatatt aatagataat caaactttta gtggttttca gtttatttta 9240
aatcaatatg gttgtatcgt ttatcataaa ggactcaaaa aaatcacaac tactacttac 9300
aatcaatttt tgacatggaa agacatcagc cttagcagat taaatgtttg ctttaattact 9360
tggataagta attgttttaa tacattaaac aaaagcttag ggctgagatg tggattcaat 9420

```

aatgttgtgt tatcacaatt atttctttat ggagattgta tactgaaatt atttcataat 9480  
gaaggcttct acataataaa agaagtagag ggatttatta tgtctttaat tctaacaata 9540  
acagaagaag atcaatttaa gaaacgattt tataatagca tgctaaataa catcacagat 9600  
gcagctatta aggctcaaaa ggacctacta tcaagagtat gtcacacttt attagacaag 9660  
acagtgtctg ataatatcat aaatggtaaa tggataatcc tattaagtaa atttcttaaa 9720  
ttgattaagc ttgcagggtga taataatctc aataacttga gtgagctata ttttctcttc 9780  
agaatctttg gacatccaat ggtcgtatga agacaagcaa tggattctgt aagaattaac 9840  
tgtaatgaaa ctaggttcta cttattaagt agtctaagta cattaagagg tgctttcatt 9900  
tatagaatca taaaagggtt tgtaaatacc tacaacagat ggcccacctt aaggatgct 9960  
attgtcctac ctctaagatg gttaaactac tataaactta atacttatcc atctctactt 10020  
gaaatcacag aaaatgattt gattatttta tcaggattgc ggttctatcg tgagtttcat 10080  
ctgcctaaaa aagtggatct tgaaatgata ataaatgaca aagccatttc acctccaaaa 10140  
gatctaatat ggactagttt tctagaaat tacatgccat cacatatata aaattatata 10200  
gaacatgaaa agttgaagtt ctctgaaagc gacagatcga gaagagtact agagtattac 10260  
ttgagagata ataaattcaa tgaatgcgat ctatacaatt gtgtagtcaa tcaaagctat 10320  
ctcaacaact ctaatcacgt ggtatcacta actggtaaag aaagagagct cagtgtagggt 10380  
agaatgtttg ctatgcaacc aggtatgttt aggcaaatcc aaatcttagc agagaaaatg 10440  
atagctgaaa atattttaca attcttcctt gagagtttga caagatatgg tgatctagag 10500  
cttcaaaaaga tattagaatt aaaagcagga ataagcaaca agtcaaactg ttataatgat 10560  
aactacaaca attatatcag taaatgttct atcattacag atcttagcaa attcaatcag 10620  
gcatttagat atgaaacatc atgtatctgc agtgatgtat tagatgaact gcatggagta 10680  
caatctctgt tctcttggtt gcatttaaca atacctcttg tcacaataat atgtacatat 10740  
agacatgcac ctcttttcat aaaggatcat gttgttaatc ttaatgaggt tgatgaacaa 10800  
agtggattat acagatatca tatgggtggt attgagggtt ggtgtcaaaa actgtggacc 10860  
attgaagcta tatcattatt agatctaata tctctcaaag ggaaattctc tatcacagct 10920  
ctgataaatg gtgataatca gtcaattgat ataagcaaac cagttagact tatagagggt 10980  
cagacccatg cacaagcaga ttatttggtt gcattaaata gccttaaat gttatataaa 11040  
gagtatgcag gtataggcca taagcttaag ggaacagaga cctatatatc ccgagatatg 11100  
cagttcatga gcaaaaacat ccagcacat ggagtgtact atccagccag tatcaaaaaa 11160  
gtcctgagag taggtccatg gataaacacg atacttgatg attttaaagt tagtttagaa 11220  
tctataggca gcttaacaca ggagttagaa tacagaggag aaagcttatt atgcagttta 11280  
atatttagga acatttggtt atacaatcaa attgctttgc aactccgaaa tcatgcatta 11340  
tgtaacaata agctatatatt agatatattg aaagtattaa aacacttaaa aacttttttt 11400  
aatcttgata gcattgatat ggctttatca ttgtatatga atttgcctat gctgtttggt 11460  
ggtggtgatc ctaatttggt atatcgagc ttttatagga gaactccaga cttccttaca 11520  
gaagctatag tacattcagt gtttgtgttg agctattata ctggtcacga tttacaagat 11580  
aagctccagg atcttcaga tgatagactg aacaaattct tgacatgtgt catcacattt 11640  
gataaaaatc ccaatgccga gtttgtaaca ttgatgagg atccacaggc tttagggtct 11700  
gaaaggcaag ctaaaattac tagtgagatt aatagattag cagtaacaga agtcttaagt 11760  
atagcccaa acaaaatatt ttctaaaagt gcacaacatt atactaccac tgagattgat 11820  
ctaaatgaca ttatgcaaaa tatagaacca acttaccctc atggattaag agttgtttat 11880  
gaaagtttac ctttttataa agcagaaaaa atagttaatc ttatatcagg aacaaaatcc 11940  
ataactaata tacttgaaaa aacatcagca atagatacaa ctgatattaa tagggctact 12000  
gatatgatga ggaaaaatat aactttactt ataaggatac ttccactaga ttgtaacaaa 12060  
gacaaaagag agttattaag tttagaaaat cttagtataa ctgaattaag caagtatgta 12120  
agagaaagat cttggctcatt atccaatata gtaggagtaa catcgccaag tattatgttc 12180  
acaatgaaca ttaaataatc aactagcact atagccagtg gtataataat agaaaaatat 12240  
aatgttaata gtttaactcg tggtgaaaga ggaccaccca agccatgggt aggtcatcc 12300

acgcaggaga aaaaaacaat gccagtgtac aacagacaag ttttaaccaa aaagcaaaga 12360  
 gaccaaataag atttatttagc aaaatttagac tgggtatatg catccataga caacaaagat 12420  
 gaattcatgg aagaactgag tactggaaca cttggactgt catatgaaaa agccaaaaag 12480  
 ttgtttccac aatatctaag tgtcaattat ttacaccgtt taacagtcag tagtagacca 12540  
 tgtgaattcc ctgcatcaat accagcttat agaacaacaa attatcattt tgatactagt 12600  
 cctatcaatc atgtattaac agaaaagtat ggagatgaag atatcgacat tgtgtttcaa 12660  
 aattgcataa gtttttggtct tagcctgatg tcggttggtg aacaattcac aaacatatgt 12720  
 cctaatagaa ttattctcat accgaagctg aatgagatac atttgatgaa acctcctata 12780  
 tttacaggag atgttgatat catcaagttg aagcaagtga tacaaaagca gcacatgttc 12840  
 ctaccagata aaataagttt aacccaatat gtagaattat tcttaagtaa caaagcactt 12900  
 aaatctggat ctccatcaa ctctaattta atattagtac ataaaatgtc tgattatttt 12960  
 cataatgctt atattttaag tactaattta gctggacatt ggattctgat tattcaactt 13020  
 atgaaagatt caaaaggtat ttttgaaaaa gattggggag aggggtacat aactgatcat 13080  
 atgttcatta atttgaatgt tttctttaat gcttataaga cttatttgct atgttttcat 13140  
 aaaggttatg gtaaagcaaa attagaatgt gatatgaaca cttcagatct tctttgtgtt 13200  
 ttggagttaa tagacagtag ctactggaaa tctatgtcta aagttttcct agaacaaaaa 13260  
 gtcataaaat acatagtcaa tcaagacaca agtttgctga gaataaaagg ctgtcacagt 13320  
 ttttaagttgt ggttttttaa acgccttaat aatgctaaat ttaccgtatg cccttgggtt 13380  
 gttaacatag attatcaccc aacacacatg aaagctatat tatcttacat agatttagtt 13440  
 agaatggggt taataaatgt agataaatta accattaaaa ataaaaacaa attcaatgat 13500  
 gaattttaca catcaaactt cttttacatt agttataact tttcagacaa cactcatttg 13560  
 ctaacaaaac aaataagaat tgctaattca gaattagaag ataattataa caaactatat 13620  
 caccacaacc cagaaacttt agaaaatatg tcattaattc ctgttaaaag taataatagt 13680  
 aacaaacctt aattttgtat aagtggaaat accgaatcta tgatgatgtc aacattctct 13740  
 agtaaaatgc atattaaatc ttccactgtt accacaagat tcaattatag caaacaagac 13800  
 ttgtacaatt tatttccaat tgttgtgata gacaagatta tagatcattc aggtaataca 13860  
 gcaaaatcta accaacttta caccaccact tcacatcaga catctttagt aaggaaatgt 13920  
 gcatcacttt attgcatgct tccttggcat catgtcaata gatttaactt tgtatttagt 13980  
 tccacaggat gcaagatcag tatagagtat attttaaaag atcttaagat taaggacccc 14040  
 agttgtatag cattcatagg tgaaggagct ggtaacttat tattacgtac ggtagtagaa 14100  
 cttcatccag acataagata catttacaga agtttaaaag attgcaatga tcatagttta 14160  
 cctattgaat ttctaagggt atacaacggg catataaaca tagattatgg tgagaattta 14220  
 accattcctg ctacagatgc aactaataac attcattggt cttatttaca tataaaattt 14280  
 gcagaacctt ttagcatctt tgtctgcgat gctgaattac ctgttacagc caattggagt 14340  
 aaaattataa ttgaatggag taagcatgta agaaagtga agtactgttc ttctgtaaat 14400  
 agatgcattt taattgcaaa atatcatgct caagatgaca ttgatttcaa attagataac 14460  
 attactatat taaaaactta cgtgtgcta ggtagcaagt taaaaggatc tgaagtttac 14520  
 ttaatcctta caataggccc tgcaaatata ctctctgtt ttgatgttgt acaaaatgct 14580  
 aaattgatac tttcaagaac taaaaatttc attatgccta aaaaaactga caaggaatct 14640  
 atcgatgcaa atattaaaag ctttaatacct tccttttgtt accctataac aaaaaagga 14700  
 attaagactt cattgtcaaa attgaagagt gtagttaatg gagatatatt atcatattct 14760  
 atagctggac gtaatgaagt attcagcaac aagcttataa accacaagca tatgaatatc 14820  
 ctaaaatggc tagatcatgt tttaaatttt agatcagctg aacttaatta caatcattta 14880  
 tacatgatag agtccacata tccttactta agtgaattgt taaatagttt aacaaccaat 14940  
 gagctcaaga agctgattaa aataacaggt agtgtgctat acaaccttcc caacgaacag 15000  
 tagtttaaaa tatcattaac aagtttggtc aaatttagat gctaacacat cattatatta 15060  
 tagttattaa agaatataca aacttttcaa taatttagca tattgattcc aaaattatca 15120  
 ttttagtctt aaggggttaa ataaaagtct aaaactaaca attatacatg tgcattcaca 15180



acacaacgag acattagttt ttgacacttt ttttctcgt

15219

<210> 12

<211> 15219

<212> DNA

<213> respiratory syncytial virus

<400> 12

```

acgggaaaaa aatgcgtact acaaacttgc acattcgaaa aaaatggggc aaataagaac 60
ttgataagtg ctatttaagt ctaacctttt caatcagaaa tgggggtgcaa ttcactgagc 120
atgataaagg ttagattaca aaatttattt gacaatgacg aagtagcatt gttaaaaata 180
acatgttata ctgataaatt aattcttctg accaatgcat tagccaaagc agcaatacat 240
acaattaaat taaacggcat agtttttata catgttataa caagcagtga agtgtgccct 300
gataacaata ttgtagtga atctaacttt acaacaatgc caatactaca aaatggagga 360
tacatatggg aattgattga gttgacacac tgctctcaat taaacggttt aatggatgat 420
aattgtgaaa tcaaattttc taaaagacta agtgactcag taatgactaa ttatatgaat 480
caaatatctg acttacttgg gcttgatctc aattcatgaa ttatgtttag tctaattcaa 540
tagacatgtg tttattacca ttttagttaa tataaaaact catcaaaggg aaatggggca 600
aataaactca cctaatacat caaacatga gcactacaaa tgacaacact actatgcaaa 660
gattgatgat cacagacatg agaccctgt caatggattc aataataaca tctcttacca 720
aagaaatcat cacacacaaa ttcataact tgataaacia tgaatgtatt gtaagaaaac 780
ttgatgaaag acaagctaca tttacattct tagtcaatta tgagatgaag ctactgcaca 840
aagtagggag taccaaatac aaaaaatata ctgaatataa tacaaaatat ggcaacttcc 900
ccatgcctat atttatcaat cacggcgggt ttctagaatg tattggcatt aagcctacaa 960
aacacactcc tataatatac aaatatgacc tcaaccctg aattccaaca aaaaaaccaa 1020
cccaaccaa ccaaactatt cctcaaacia cagtgtctca tagttaagaa ggagctaata 1080
catttttagt attaaaaata aaagtaaagc caataacata aattggggca aatacaaga 1140
tggctcttag caaagtcaag ttgaatgata cattaaataa ggatcagctg ctgtcatcca 1200
gcaaatacac tattcaacgt agtacaggag ataatttga cactcccaat tatgatgtgc 1260
aaaaacacct aaacaaacta tgtggtatgc tattaatcac tgaagatgca aatcataaat 1320
tcacaggatt aataggtatg ttatatgcta tgtccagggt aggaaggga gacactataa 1380
agatacttaa agatgctgga tatcatgtta aagctaattg agtagatata acaacatatc 1440
gtcaagatat aaatggaaag gaaatgaaat tcgaagtatt aacattatca agcttgacat 1500
cagaaataca agtcaatatt gagatagaat ctagaaagtc ctacaaaaaa atgctaaaag 1560
agatgggaga agtggtcca gaatataggc atgattctcc agactgtggg atgataatac 1620
tgtgtatagc tgcacttgtg ataaccaaat tagcagcagg agacagatca ggtcttaagc 1680
cagtaattag gagggcaaac aatgtcttaa aaaacgaaat aaaacgatac aagggcctca 1740
taccaaagga tatagctaac agtttttatg aagtgtttga aaaacacct catcttatag 1800
atgttttctg gcactttggc attgcacaat catccacaag agggggtagt agagttgaag 1860
gaatctttgc aggattgttt atgaatgcct atggttcagg gcaagtaatg ctaagatggg 1920
gagtttttag caaatctgta aaaaatatca tgctaggaca tgctagtgtc caggcagaaa 1980
tggagcaagt tgtggaagtc tatgagtatg cacagaagtt gggaggagaa gctggattct 2040
accatatatt gaacaatcca aaagcatcat tgctgtcatt aactcaattt cccaacttct 2100
caagtgtggt cctaggcaat gcagcaggtc taggcataat gggagagtat agaggtagac 2160
caagaaacca ggatctttat gatgcagcta aagcatatgc agagcaactc aaagaaaatg 2220
gagtaataaa ctacagtgtg ttagacttaa cagcagaaga attggaagcc ataaagcatc 2280
aactcaacc caaagaagat gatgtagagc ttttaagttaa caaaaaatac ggggcaataa 2340
agtcaacatg gagaagttt cacctgaatt tcatggagaa gatgcaataa acaaagctac 2400

```

```

caaattccta gaatcaataa agggcaagtt cgcacatcc aaagatccta agaagaaaga 2460
tagcataata tctgttaact caatagatat agaagtaact aaagagagcc cgataacatc 2520
tggcaccaac atcatcaatc caacaagtga agccgacagt accccagaaa caaaagccaa 2580
ctacccaaga aaacccttag taagcttcaa agaagatctc accccaagtg acaacccttt 2640
ttctaagttg tacaaggaaa caatagaaac atttgataac aatgaagaag aatctagcta 2700
ctcatatgaa gagataaatg atcaacaaa tgacaacatt acagcaagac tagatagaat 2760
tgatgaaaaa ttaagtgaat tattaggaat gctccataca ttagtagttg caagtgcagg 2820
accacttca gctcgcgatg gaataagaga tgctatgggt ggtctaagag aagagatgat 2880
agaaaaata agagcggaag cattaatgac caatgatagg ttagaggcta tggcaagact 2940
taggaatgag gaaagcgaaa aaatggcaaa agacacctca gatgaagtgt ctcttaatcc 3000
aacttccaaa aaattgagtg acttggttga agacaacgat agtgacaatg atctatcact 3060
tgatgatttt tgatcagcga tcaactcact cagcaatcaa caacatcaat aaaacagaca 3120
tcaatccatt gaatcaactg ccagaccgaa caaacaacg tccatcagta gaaccaccaa 3180
ccaatcaatc aaccaattga tcaatcagca acccgacaaa attaacaata tagtaacaaa 3240
aaaagaacaa gatggggcaa atatggaaac atacgtgaac aagcttcacg aaggctccac 3300
atacacagca gctgttcagt acaatgttct agaaaaagat gatgatcctg catcactaac 3360
aatatgggtg cctatgttcc agtcatctgt gccagcagac ttgctcataa aagaacttgc 3420
aagcatcaat atactagtga agcagatctc tacgccccaa ggaccttcac tacgagtcac 3480
gattaactca agaagtgtg tgctggctca aatgcctagt aatttcatca taagcgcaaa 3540
tgtatcatta gatgaaagaa gcaaattagc atatgatgta actacacctt gtgaaatcaa 3600
agcatgcagt ctaacatgct taaaagtaaa aagtatgtta actacagtca aagatcttac 3660
catgaagaca ttcaacccca ctcatgagat cattgtctta tgtgaatttg aaaaattat 3720
gacatcaaaa agagtaataa taccaacctt tctaagatca attagtgtca agaacaagga 3780
tctgaactca ctagaaaata tagcaaccac cgaattcaaa aatgctatca ccaatgcaaa 3840
aattattcct tatgcaggat tagtgttagt tatcacagtt actgacaata aaggagcatt 3900
caaatatatc aaaccacaga gtcaatttat agtagatctt ggtgcctacc tagaaaaaga 3960
gagcatatat tatgtgacta ctaattggaa gcatacagct acacgttttt caatcaaac 4020
actagaggat taaacttaat tatcaacact gaatgacagg tccacatata tcttcaaac 4080
acacactata tccaaacatc ataaacatct acactacaca cttcatcaca caaaccaatc 4140
ccactcaaaa tccaaaatca ctaccagcca ctatctgcta gacctagagt gcgaataggt 4200
aaataaaacc aaaatatggg gtaaatagac attagttaga gttcaatcaa tcttaacaac 4260
catttatacc gccaatcaa cacatatact ataaatctta aaatgggaaa tacatccatc 4320
acaatagaat tcacaagcaa attttggccc tattttacac taatacatat gatcttaact 4380
ctaattcttt tactaattat aatcactatt atgattgcaa tactaaataa gctaagtga 4440
cataaagcat tctgtaacaa aactcttgaa ctaggacaga tgtatcaaat caacacatag 4500
agttctacca ttatgtgtg tcaaattata atcctgtata tataaacaaa caaatccaat 4560
cttctcacag agtcatggtg tcgcaaaacc acgctaacta tcatggtagc atagagtagt 4620
tatttaaaaa ttaacataat gatgaattgt tagtatgaga tcaaaaacaa cattggggca 4680
aatgcaacca tgtccaaaca caagaatcaa cgcactgcca ggactctaga aaagacctgg 4740
gatactctta atcatcta atgtaatatcc tcttgtttat acagattaaa tttaaaatct 4800
atagcacaaa tagcactatc agttttggca atgataatct caacctctct cataattgca 4860
gccataatat tcatcatctc tgccaatcac aaagttacac taacaacggt cacagttcaa 4920
acaataaaaa accacactga aaaaaacatc accacctacc ctactcaagt ctaccagaa 4980
agggttagtt catccaagca acccacaacc acatcaccaa tccacacaag ttcagctaca 5040
acatcaccca atacaaaatc agaaacacac catacaacag cacaaccaa aggcagaacc 5100
accacttcaa cacagaccaa caagccaagc acaaaaaccac gtccaaaaaa tccacaaaaa 5160
aaagatgatt accatthtga agtgttcaac ttcgttcctt gcagtatatg tggcaacaat 5220
caactttgca aatccatctg caaaacaata ccaagcaaca aaccaaaaga gaaaccaacc 5280

```

```

atcaaaccca caaacaaacc aaccacaaa accacaaaca aaagagacc aaaacacca 5340
gccaaaacga cgaaaaaaga aactaccacc aaccaacaa aaaaactaac cctcaagacc 5400
acagaaagag acaccagcac ctcacaatcc actgcactcg acacaaccac attaaaacac 5460
acagtccaac agcaatccct cctctcaacc acccccgaaa acacacccaa ctccacacaa 5520
acaccacag catccgagcc ctccacacca aactccaccc aaaaaacca gccacatgct 5580
tagttattca aaaactacat cttagcagag aaccgtgatc tatcaagcaa gaacgaaatt 5640
aaacctgggg caaataacca tggagtgtgat gatccacaag tcaagtgcaa tcttcctaac 5700
tcttgctatt aatgcattgt acctcacctc aagtcagaac ataactgagg agttttacca 5760
atcgacatgt agtgcagtta gcagagggtta ttttagtgct ttaagaacag gttggtatac 5820
tagtgtcata acaatagaat taagtaatat aaaagaaacc aaatgcaatg gaactgacac 5880
taaagtaaaa cttatgaaac aagaattaga taagtataag aatgcagtaa cagaattaca 5940
gctacttatg caaacacac cagctgtcaa caaccgggccc agaagagaag caccacagta 6000
tatgaactac acaatcaata ccactaaaaa cctaaatgta tcaataagca agaagaggaa 6060
acgaagatth ctaggcttct tggtaggtgt gggatctgca atagcaagtg gtatagctgt 6120
atcaaaagtt ctacaccttg aaggagaagt gaacaagatc aaaaatgctt tgttgcttac 6180
aaacaaagct gtagtcagtt tatcaaatgg ggtcagtggt ttaaccagca aagtgttaga 6240
tctcaagaat tacataaata accaattatt acccatagta aatcaacaga gctgtcgcat 6300
ctccaacatt gaaacagtta tagaattcca gcagaagaac agcagattgt tggaaatcac 6360
cagagaatth agtgtcaatg caggtgtaac aacaccttta agcacttaca tgttgacaaa 6420
cagtgcagtt ctatcattaa tcaatgatat gcctataaca aatgatcaga aaaaattaat 6480
gtcaagcaat gttcagatag taaggcaaca aagttattcc atcatgtcta taataaagga 6540
agaagtccct gcatatgttg tacagctgcc tatctatggt gtaatagata caccttgctg 6600
gaaattgcac acatcgctc tatgcactac caacatcaaa gaaggatcaa atatttgtht 6660
aacaaggact gatagaggat ggtattgtga taatgcagga tcagtatcct tctttccaca 6720
ggctgacact tgtaaagtac agtccaatcg agtattttgt gacactatga acagtttgac 6780
attaccaagt gaagttagcc tttgtaaacac tgacatatc aattccaagt atgactgcaa 6840
aattatgaca tcaaaaacag acataagcag ctcagtaatt acttctcttg gagctatagt 6900
gtcatgctat ggtaaaacta aatgcactgc atccaacaaa aatcgtggga ttataaagac 6960
atthttcta at ggttgtagct atgtgtcaaa caaaggagta gatactgtgt cagtgggcaa 7020
cactttatac tatgtaaaaca agctggaagg caagaacctt tatgtaaaag gggaacctat 7080
aataaattac tatgacctc tagtgthtcc ttctgatgag tttgatgcat caatatctca 7140
agtcaatgaa aaaatcaatc aaagthtagc thttattcgt agatctgatg aattactaca 7200
taatgtaaat actggcaaat ctactacaaa tattatgata actacaatta ttatagtaat 7260
cattgtagta ttgttatcat taatagctat tggthtactg ttgtattgta aagccaaaaa 7320
cacaccagtt acactaagca aagaccaact aagtggatc aataatattg cattcagcaa 7380
atagacaaaa aaccacctga tcatgtthca acaacaatct gctgaccacc aatcccaat 7440
caacttaca caaatattc aacatcacag tacaggctga atcatttcct cacatcatgc 7500
taccacata actaagctag atccttaact tatagttaca taaaaacctc aagtatcaca 7560
atcaaccact aaatcaacac atcattcaca aaattaacag ctggggcaaa tatgtcgcga 7620
agaaatccct gtaaatthga gattagaggt cattgctthga atggtagaag atgtcactac 7680
agtcataat actthgaatg gcctcctcat gcattactag tgaggcaaaa ctthcatgta 7740
aacaagatac tcaagtcaat ggacaaaagc atagacactt tgtctgaaat aagtggagct 7800
gctgaactgg atagaacaga agaatatgct cthggtatag thggagtgt agagagttac 7860
ataggatcta taaacaacat acaaaaacaa tcagcatgtg thgctatgag taaacttht 7920
attgagatca atagtgtatga cattaaaaag cthtagagata atgaagaacc caattcacct 7980
aagataagag tgtacaatac thgttatatca tacattgaga gcaatagaaa aaacaacaag 8040
caaaccatcc atctgtctaa gagactacca gcagacgtgc tgaagaagac aataaagaac 8100
acattagata tccacaaaag cataaccata agcaatccaa aagagtcaac thgtgaatgat 8160

```

```

caaaatgacc aaacccaaaa taatgatatt accggataaa tatccttgta gtatatcatc 8220
catattgatc tcaagtgaag gcatgggtgc tacattcaat cataaaaaaca tattacaatt 8280
taaccataac tatttgata accaccagcg tttattaaat catatatttg atgaaattca 8340
ttggacacct aaaaacttat tagatgccac tcaacaattt ctccaacatc ttaacatccc 8400
tgaagatata tatacagtat atatattagt gtcataatgc ttgaccataa cgactctatg 8460
tcatccaacc ataaaactat tttgataagg ttatgggaca aaatggatcc cattattaat 8520
ggaaactctg ctaatgtgta tctaactgat agttatttaa aagggtgttat ctctttttca 8580
gagtgtaatg ctttagggag ttatcttttt aacggccctt atcttaaaaa tgattacacc 8640
aacttaatta gtagacaaag cccactacta gagcatatga atcttaaaaa actaactata 8700
acacagtcac taatatctag atatacaaaa ggtgaactga aattagaaga accaacttat 8760
ttccagtcac tacttatgac atataaaagt atgtcctcgt ctgaacaaat tgctacaact 8820
aacttactta aaaaaataat acgaagagcc atagaaataa gtgatgtaa ggtgtacgcc 8880
atcttgaata aactaggatt aaaggaaaag gacagagtta agcccaacaa taattcaggt 8940
gatgaaaact cagtacttac aactataatt aaagatgata tactttcggc tgtggaaaac 9000
aatcaatcat atacaaattc agacaaaagt cactcagtaa atcaaaatat cactatcaaa 9060
acaacactct tgaaaaaatt gatgtgttca atgcaacatc ctccatcatg gtttaatacac 9120
tggttcaatt tatatacaaa attaaataac atattaacac aatctcgatc aaatgaggta 9180
aaaagtcacg ggttttatatt aatagataat caaactttta gtggttttca gtttatttta 9240
aatcaatatg gttgtatcgt ttatcataaa ggactcaaaa aaatcacaac tactacttac 9300
aatcaatttt tgacatggaa agacatcagc cttagcagat taaatgtttg ctttaattact 9360
tggataagta attgttttaa tacattaaac aaaagcttag ggctgagatg tggattcaat 9420
aatgttgtgt tatcacaatt atttctttat ggagattgta tactgaaatt atttcataat 9480
gaaggcttct acataataaa agaagtagag ggatttatta tgtctttaat tctaacata 9540
acagaagaag atcaatttag gaaacgattt tataatagca tgctaaataa catcacagat 9600
gcagctatta aggtcaaaa ggacctacta tcaagagtat gtcacacttt attagacaag 9660
acagtgtctg ataatatcat aaatggtaaa tggataatcc tattaagtaa atttcttaa 9720
ttgattaagc ttgcaggatg taataatctc aataacttga gtgagctata tttctcttc 9780
agaatctttg gacatccaat ggtcgatgaa agacaagcaa tggattctgt aagaattaac 9840
tgtaatgaaa ctaagtctta cttattaagt agtctaagta cattaagagg tgctttcatt 9900
tatagaatca taaaaggggt tgtaaatacc tacaacagat ggcccacctt aaggaaatgct 9960
attgtcctac ctctaagatg gttaaactac tataaactta atacttatcc atctctactt 10020
gaaatcacag aaaatgattt gattatttta tcaggattgc ggttctatcg tgagtttcat 10080
ctgcctaaaa aagtggatct tgaaatgata ataatgaca aagccatttc acctcaaaa 10140
gatctaatat ggactagttt tctagaaat tacatgccat cacatataca aaattatata 10200
gaacatgaaa agttgaagtt ctctgaaagc gacagatoga gaagagtact agagtattac 10260
ttgagagata ataaattcaa tgaatgogat ctatacaatt gtgtagtcaa tcaaagctat 10320
ctcaacaact ctaatcacgt ggtatcacta actggttaaag aaagagagct cagtgtaggt 10380
agaatgtttg ctatgcaacc aggtatgttt aggcaatcc aaatcttagc agagaaaatg 10440
atagctgaaa atattttaca attcttcctt gagagtttga caagatatgg tgatctagag 10500
cttcaaaaga tattagaatt aaaagcagga ataagcaaca agtcaaatcg ttataatgat 10560
aactacaaca attatatcag taaatgttct atcattacag atcttagcaa attcaatcag 10620
gcatttagat atgaaacatc atgtatctgc agtgatgtat tagatgaact gcatggagta 10680
caatctctgt tctcttggtt gcatttaaca atacctcttg tcacaataat atgtacatat 10740
agacatgcac ctcttttcat aaaggatcat gttgttaatc ttaatgaggt tgatgaacaa 10800
agtggattat acagatatca tatgggtggt attgagggct ggtgtcaaaa actgtggacc 10860
attgaagcta tatcattatt agatctaata tctctcaaag ggaaattctc tatcacagct 10920
ctgataaatg gtgataatca gtcaattgat ataagcaaac cagttagact tatagagggg 10980
cagacccatg cacaagcaga ttatttgta gcattaaata gccttaaat gttatataaa 11040

```

gagtatgcag gtataggcca taagcttaag ggaacagaga cctatatatc ccgagatatg 11100  
 cagttcatga gcaaaacaat ccagcacaat ggagtgtact atccagccag tatcaaaaaa 11160  
 gtcctgagag taggtccatg gataaacacg atacttgatg attttaaagt tagtttagaa 11220  
 tctataggca gcttaacaca ggagttagaa tacagaggag aaagcttatt atgcagttta 11280  
 atatttagga acatttggtt atacaatcaa attgctttgc aactocgaaa tcatgcatta 11340  
 tgtaacaata agctatatatt agatatattg aaagtattaa aacacttaaa aacttttttt 11400  
 aatcttgata gcattgatat ggctttatca ttgtatatga atttgcctat gctgtttggt 11460  
 ggtggtgatc ctaatttggt atatcgaagc ttttatagga gaactccaga cttccttaca 11520  
 gaagctatag tacattcagt gtttgtgttg agctattata ctggtcacga tttacaagat 11580  
 aagctccagg atcttcaga tgatagactg aacaaattct tgacatgtgt catcacattt 11640  
 gataaaaatc ccaatgccga gtttgaaca ttgatgaggg atccacaggc tttagggtct 11700  
 gaaaggcaag ctaaaattac tagtgagatt aatagattag cagtaacaga agtcttaagt 11760  
 atagcccaa acaaaatatt ttctaaaagt gcacaacatt atactaccac tgagattgat 11820  
 ctaaattgaca ttatgcaaaa tatagaacca acttaccctc atggattaag agttgtttat 11880  
 gaaagtttac ctttttataa agcagaaaaa atagttaatc ttatatcagg aacaaaatcc 11940  
 ataactaata tacttgaaaa aacatcagca atagatacaa ctgatattaa tagggctact 12000  
 gatatgatga ggaaaaatat aactttactt ataaggatac ttccactaga ttgtaacaaa 12060  
 gacaaaagag agttattaag ttttagaaaat cttagtataa ctgaattaag caagtatgta 12120  
 agagaaagat cttggtcatt atccaatata gtaggagtaa catcgccaag tattatgttc 12180  
 acaatggaca ttaaataatc aactagcact atagccagtg gtataataat agaaaaatat 12240  
 aatgttaata gtttaactcg tggtgaaaga ggacccacca agccatgggt aggtcatcc 12300  
 acgcaggaga aaaaaacaat gccagtgtac aacagacaag ttttaaccaaa aaagcaaaaga 12360  
 gaccaaatag atttattagc aaaattagac tgggtatatg catccataga caacaaagat 12420  
 gaattcatgg aagaactgag tactggaaca cttggactgt catatgaaaa agccaaaaag 12480  
 ttgtttccac aatatctaag tgtcaattat ttacaccgtt taacagtcag tagtagacca 12540  
 tgtgaattcc ctgcatcaat accagcttat agaacaacaa attatcattt tgatactagt 12600  
 cctatcaatc atgtattaac agaaaagtat ggagatgaag atatcgacat tgtgtttcaa 12660  
 aattgcataa gttttggtct tagcctgatg tcggttgttg aacaattcac aaacatatgt 12720  
 cctaatagaa ttattctcat accgaagctg aatgagatac atttgatgaa acctcctata 12780  
 tttacaggag atgttgatat catcaagttg aagcaagtga tacaaaagca gcacatgttc 12840  
 ctaccagata aaataagttt aaccaatat gtagaattat tcttaagtaa caaagcactt 12900  
 aaatctggat ctacatcaa ctctaattta atattagtac ataaaatgtc tgattatttt 12960  
 cataatgctt atattttaag tactaattta gctggacatt ggattctgat tattcaactt 13020  
 atgaaagatt caaaaggtat ttttgaaaaa gattggggag aggggtacat aactgatcat 13080  
 atgttcatta atttgaatgt tttctttaat gcttataaga cttatttgct atgttttcat 13140  
 aaaggttatg gtaaagcaaa attagaatgt gatatgaaca cttcagatct tctttgtgtt 13200  
 ttggagttaa tagacagtag ctactggaat tctatgtcta aagttttcct agaacaaaaa 13260  
 gtcataaaat acatagtcaa tcaagacaca agtttgcgta gaataaaagg ctgtcacagt 13320  
 ttttaagttg ggttttttaa acgccttaat aatgctaaat ttaccgtatg cccttgggtt 13380  
 gttacatag attatcaccc aacacacatg aaagctatat tatcttacat agatttagtt 13440  
 agaattgggt taataaatgt agataaatta accattaaaa ataaaaacaa attcaatgat 13500  
 gaattttaca catcaaactt cttttacatt agttataact tttcagacaa cactcatttg 13560  
 ctaacaaaac aaataagaat tgctaattca gaattagaag ataattataa caaactatat 13620  
 caccacccc cagaaacttt agaaaatatg tcattaattc ctgttaaaag taataatagt 13680  
 aacaaacctt aattttgtat aagtggaaat accgaatcta tgatgatgtc aacattctct 13740  
 agtaaaatgc atattaaatc ttccactgtt accacaagat tcaattatag caaacaagac 13800  
 ttgtacaatt tatttccaat tgttgtgata gacaagatta tagatcattc aggtaatata 13860  
 gcaaaatcta accaacttta caccaccact tcacatcaga catctttagt aaggaaatagt 13920

```

gcatcacttt attgcatgct tccttggcat catgtcaata gatttaactt tgtatttagt 13980
tccacaggat gcaagatcag tatagagtat attttaaaag atcttaagat taaggacccc 14040
agttgtatag cattcatagg tgaaggagct ggtaacttat tattacgtac ggtagtagaa 14100
cttcatccag acataagata catttacaga agtttaaaag attgcaatga tcatagttta 14160
cctattgaat ttctaagggt atacaacggg catataaaca tagattatgg tgagaattta 14220
accattcctg ctacagatgc aactaataac attcattgggt cttatttaca tataaaatth 14280
gcagaacctt ttagcatctt tgtctgcgat gctgaattac ctgttacagc caattggagt 14340
aaaattataa ttgaatggag taagcatgta agaaagtgca agtactgttc ttctgtaaat 14400
agatgcattt taattgcaaa atatcatgct caagatgaca ttgatttcaa attagataac 14460
attactatat taaaaactta cgtgtgccta ggtagcaagt taaaaggatc tgaagtttac 14520
ttaatcctta caataggccc tgcaaatata cttcctgttt ttgatgttgt acaaaatgct 14580
aaattgatac tttcaagaac taaaaatthc attatgccta aaaaaactga caaggaatct 14640
atcgatgcag atattaaaag cttataacct ttcctttgtt accctataac aaaaaaagga 14700
attaagactt cattgtcaaa attgaagagt gtagttaatg gagatatatt atcatattct 14760
atagctggac gtaatgaagt attcagcaac aagcttataa accacaagca tatgaatatt 14820
ctaaaatggc tagatcatgt tttaaaattht agatcagctg aacttaatta caatcattta 14880
tacatgatag agtccacata tccttactta agtgaattgt taaatagttt aacaaccaat 14940
gagctcaaga agctgattaa aataacagggt agtgtgctat acaaccttcc caacgaacag 15000
tagtttaaaa tatcattaac aagtttgggc aaatttagat gctaacacat cattatatta 15060
tagttattaa aaaatatata aacttttcaa taatttagca tattgattcc aaaattatca 15120
ttttagtctt aaggggttaa ataaaagtct aaaactaaca attatacatg tgcattcaca 15180
acacaacgag acattagttt ttgacacttt ttttctcgt 15219

```

&lt;210&gt; 13

&lt;211&gt; 15219

&lt;212&gt; DNA

&lt;213&gt; respiratory syncytial virus

&lt;400&gt; 13

```

acgggaaaaa aatgcgtact acaacttgc acattcgaaa aaaatggggc aaataagaac 60
ttgataagtg ctatttaagt ctaacctttt caatcagaaa tgggggtgca ttactgagc 120
atgataaagg ttagattaca aaatttattt gacaatgacg aagtagcatt gttaaaaaata 180
acatgttata ctgataaatt aattcttctg accaatgcat tagccaaagc agcaatacat 240
acaattaaat taaacggcat agtttttata catgttataa caagcagtga agtgtgccct 300
gataacaata ttgtagtga atctaacttt acaacaatgc caatactaca aaatggagga 360
tacatatggg aattgattga gttgacacac tgctctcaat taaacggttt aatggatgat 420
aattgtgaaa tcaaattthc taaaagacta agtgactcag taatgactaa ttatatgaat 480
caaatatctg acttacttgg gcttgatctc aattcatgaa ttatgttttag tctaattcaa 540
tagacatgtg tttattacca ttttagttaa tataaaaact catcaaaggg aaatggggca 600
aataaactca cctaatacat caaacatga gcactacaaa tgacaacact actatgcaaa 660
gattgatgat cacagacatg agaccctgt caatggattc aataataaca tctcttacca 720
aagaaatcat cacacacaaa ttcataact tgataaaca tgaatgtatt gtaagaaaac 780
ttgatgaaag acaagctaca tttacattct tagtcaatta tgagatgaag ctactgcaca 840
aagtagggag taccaaatac aaaaaatata ctgaatataa taaaaaatat ggcactttcc 900
ccatgcctat atttatcaat cacggcgggt ttctagaatg tattggcatt aagcctacaa 960
aacacactcc tataatatac aaatatgacc tcaaccgtg aattccaaca aaaaaacca 1020
cccaaccaa ccaactatt cttcaacaa cagtgtcaa tagttaagaa ggagctaatt 1080
catttttagta attaaaaata aaagtaaagc caataacata aattggggca aatacaaaaga 1140

```

tggctcttag caaagtcaag ttgaatgata cattaataaa ggatcagctg ctgtcatcca 1200  
 gcaaatacac tattcaacgt agtacaggag ataattattga cactoccaat tatgatgtgc 1260  
 aaaaacacct aaacaaacta tgtggtatgc tattaatcac tgaagatgca aatcataaat 1320  
 tcacaggatt aataggtatg ttatatgcta tgtccagggt aggaagggaa gacactataa 1380  
 agatacttaa agatgctgga tatcatgtta aagctaattg agtagatata acaacatatc 1440  
 gtcaagatat aaatggaaag gaaatgaaat tcgaagtatt aacattatca agcttgacat 1500  
 cagaaataca agtcaatatt gagatagaat ctagaaagtc ctacaaaaaa atgctaaaag 1560  
 agatggggaga agtggctcca gaatataggc atgattctcc agactgtggg atgataatac 1620  
 tgtgtatagc tgcacttgtg ataaccaaat tagcagcagg agacagatca ggtcttacag 1680  
 cagtaattag gagggcaaac aatgtcttaa aaaacgaaat aaaacgatac aagggcctca 1740  
 taccaaagga tatagctaac agtttttatg aagtgtttga aaaacaccct catcttatag 1800  
 atgttttcgt gcactttggc attgcacaat catccacaag aggggtagt agagttgaag 1860  
 gaatctttgc aggattgttt atgaatgcct atggttcagg gcaagtaatg ctaagatggg 1920  
 gagttttagc caaatctgta aaaaatatca tgctaggaca tgctagtgtc caggcagaaa 1980  
 tggagcaagt tgtggaagtc tatgagtatg cacagaagtt gggaggagaa gctggattct 2040  
 accatatatt gaacaatcca aaagcatcat tgctgtcatt aactcaattt cccaacttct 2100  
 caagtgtggt cctaggcaat gcagcaggtc taggcataat gggagagtat agaggtacac 2160  
 caagaaacca ggatctttat gatgcagcta aagcatatgc agagcaactc aaagaaaatg 2220  
 gagtaataaa ctacagtgtg ttagacttaa cagcagaaga attggaagcc ataaagcatc 2280  
 aactcaaccc caaagaagat gatgtagagc ttttaagttaa caaaaaatac ggggcaataa 2340  
 agtcaacatg gagaagtttg cacctgaatt tcatggagaa gatgcaataa acaaagctac 2400  
 caaatctcta gaatcaataa agggcaagtt cgcacatcc aaagatccta agaagaaaga 2460  
 tagcataata tctgttaact caatagatat agaagtaact aaagagagcc cgataacatc 2520  
 tggcaccaac atcatcaatc caacaagtga agccgacagt accccagaaa caaaagccaa 2580  
 ctaccaaga aaacccctag taagcttcaa agaagatctc accccaagtg acaacccttt 2640  
 ttctaagttg tacaaggaaa caatagaaac atttgataac aatgaagaag aatctagcta 2700  
 ctcatatgaa gagataaatg atcaacaaa tgacaacatt acagcaagac tagatagaat 2760  
 tgatgaaaaa ttaagtgaat tattaggaat gctccatata ttagtagttg caagtgcagg 2820  
 acccacttca gctcgcgatg gaataagaga tgctatggtt ggtctaagag aagagatgat 2880  
 agaaaaata agagcggaag cattaatgac caatgatagg ttagaggcta tggcaagact 2940  
 taggaatgag gaaagcgaaa aaatggcaaa agacacctca gatgaagtgt ctcttaatcc 3000  
 aacttccaaa aaattgagtg acttggttga agacaacgat agtgacaatg atctatcact 3060  
 tgatgatatt tgatcagcga tcaactcact cagcaatcaa caacatcaat aaaacagaca 3120  
 tcaatccatt gaatcaactg ccagaccgaa caaacaacg tccatcagta gaaccaccaa 3180  
 ccaatcaatc aaccaattga tcaatcagca acccgacaaa attaacaata tagtaacaaa 3240  
 aaaagaacaa gatggggcaa atatggaaac atacgtgaac aagcttcacg aaggctccac 3300  
 atacacagca gctgttcagt acaatgttct agaaaaagat gatgatcctg catcactaac 3360  
 aatatgggtg cctatgttcc agtcatctgt gccagcagac ttgctcataa aagaacttgc 3420  
 aagcatcaat atactagtga agcagatctc tacgcccacaa ggaccttcac tacgagtcac 3480  
 gattaactca agaagtgtg tgctggctca aatgcctagt aatttcatca taagcgcaaa 3540  
 tgtatcatta gatgaaagaa gcaaattagc atatgatgta actacacctt gtgaaatcaa 3600  
 agcatgcagt ctaacatgct taaaagtaaa aagtatgtta actacagtca aagatcttac 3660  
 catgaagaca ttcaacccca ctcatgagat cattgtctca tgtgaatttg aaaatattat 3720  
 gacatcaaaa agagtaataa tacciaacct tctaagatca attagtgtca agaacaagga 3780  
 tctgaactca ctagaaaata tagcaaccac cgaattcaaa aatgctatca ccaatgcaaa 3840  
 aattattcct tatgcaggat tagtgttagt tatcacagtt actgacaata aaggagcatt 3900  
 caaatatatc aaaccacaga gtcaatttat agtagatctt ggtgcctacc tagaaaaaga 3960  
 gagcatatat tatgtgacta ctaattggaa gcatacagct acacgttttt caatcaaacc 4020

actagaggat taaacttaat tatcaacact gaatgacagg tccacatata tcctcaaact 4080  
 acacactata tccaaacatc ataaacatct acactacaca cttcatcaca caaaccaatc 4140  
 ccactcaaaa tccaaaatca ctaccagcca ctatccgcta gacctagagt gcgaataggc 4200  
 aaataaaacc aaaaatggtg gtaaatagac attagttaga gttcaatcaa tcttaacaac 4260  
 cattttatacc gccaatcaa cacatatact ataaatctta aaatgggaaa tacatccatc 4320  
 acaatagaac tcacaagcaa attttggccc tattttacac taatacatat gatcttaact 4380  
 ctaatctttt tactaattat aatcactatc atgattgcaa cactaaataa gctaagtga 4440  
 cacaaagcat tctgcaacaa aactcttgaa ctaggacaga tgtaccaa caacacacag 4500  
 agttccacca ttatgctgtg tcaaaccata atcctgtata taaaaacaaa caaatccaat 4560  
 cctctcacag agtcacggtg tcgcaaaacc acgctaacca tcatggtagc atagagtagt 4620  
 tattttaaaa ttaacataat gatgaattgt tagtatgaga tcaaaaacaa cattggggca 4680  
 aatgcaacca tgtccaaaca caagaatcaa cgcactgcca ggactctaga aaagacctgg 4740  
 gatactctta atcatcta atgtaatatc tcttgtttat acagattaaa tttaaaatct 4800  
 atagcacaaa tagcactatc agttttggca atgataatct caacctctct cataattgca 4860  
 gccataatat tcatcatctc tgccaatcac aaagttacac taacaacggc cacagttaa 4920  
 acaataaaaa accacactga aaaaaacatc accacctacc ctactcaagt ctaccagaa 4980  
 aggggttagt catccaagca acccacaacc acatcaccaa tccacacaag ttcagtcaca 5040  
 acatcaccca atacaaaatc agaaacacac catacaacag cacaaccaa aggcagaacc 5100  
 accacttcaa cacagaccaa caagccaagc acaaaaccac gtccaaaaaa tccacaaaa 5160  
 aaagatgatt accattttga agtggtcaac ttcgttcctt gcagtatatg tggcaacaat 5220  
 caactttgca aatccatctg caaaacaata ccaagcaaca aaccaagaa gaaaccaacc 5280  
 atcaaaccca caaacaaacc aaccacaaa accacaacaa aaagagacc aaaaacacca 5340  
 gccaaaacga cgaaaaaaga aactaccacc aaccaacaa aaaaactaac cctcaagacc 5400  
 acagaaagag acaccagcac ctcaaatcc actgcactcg acacaaccac attaaaacac 5460  
 acagtccaac agcaatccct cctctcaacc accccgaaa acacacccaa ctccacacaa 5520  
 acaccacag catccgagcc ctccacacca aactccaccc aaaaaacca gccacatgct 5580  
 tagttattca aaaactacat cttagcagag aaccgtgatc tatcaagcaa gaacgaaatt 5640  
 aaacctgggg caaataacca tggagttgat gatccacaag tcaagtgc aaatcttaac 5700  
 tcttgcattt aatgcattgt acctcacctc aagtcagaac ataactgagg agttttacca 5760  
 atcgacatgt agtgcagtta gcagaggtta ttttagtgct ttaagaacag gttggtatc 5820  
 tagtgtcata acaatagaat taagtaatat aaaagaaacc aaatgcaatg gaactgacac 5880  
 taaagtaaaa cttatgaaac aagaattaga taagtataag aatgcagtaa cagaattaca 5940  
 gctacttatg caaacacac cagctgtcaa caaccgggcc agaagagaag caccacagta 6000  
 tatgaactac acaatcaata ccactaaaaa cctaaatgta tcaataagca agaagaggaa 6060  
 acgaagattt ctaggcttct tgtaggtgt gggatctgca atagcaagt gtagctgt 6120  
 atcaaaagtt ctacacctg aaggagaagt gaacaagatc aaaaatgctt tgtgtctac 6180  
 aaacaaagct gtagtcagtt tatcaaatgg ggtcagtggt ttaaccagca aagtgttaga 6240  
 tctcaagaat tacataaata accaattatt acccatagta aatcaacaga gctgtcgcat 6300  
 ctccaacatt gaaacagtta tagaattcca gcagaagaac agcagattgt tggaaatcac 6360  
 cagagaattt agtgtaatg caggtgtaac aacaccttta agcacttaca tgttgacaaa 6420  
 cagtgaagtt ctatcattaa tcaatgatat gcctataaca aatgatcaga aaaaattaat 6480  
 gtcaagcaat gttcagatag taaggcaaca aagttattcc atcatgtcta taataaagga 6540  
 agaagtcctt gcatatgttg tacagtgcc tatctatgg gtaatagata cacttgctg 6600  
 gaaattgcac acatcgctc tatgactac caacatcaa gaaggatcaa atatttgtt 6660  
 aacaaggact gatagaggat ggtattgtga taatgcagga tcagtatcct tctttccaca 6720  
 ggctgacact tgtaaagtac agtccaatcg agtattttgt gacactatga acagtgtgac 6780  
 attaccaagt gaagtcagcc tttgtaacac tgacatatc aattccaagt atgactgcaa 6840  
 aattatgaca tcaaaaacag acataagcag ctgagtaatt acttctcttg gagctatagt 6900



gtcattgctat ggtaaaacta aatgcactgc atccaacaaa aatcgtggga ttataaagac 6960  
 attttctaataa ggttgtgact atgtgtcaaa caaaggagta gatactgtgt cagtgggcaa 7020  
 cactttatac tatgtaaaca agctggaagg caagaacctt tatgtaaaag gggaacctat 7080  
 aataaattac tatgacctc tagtgtttcc ttctgatgag tttgatgcat caatatctca 7140  
 agtcaatgaa aaaatcaatc aaagtttagc ttttattcgt agatctgatg aattactaca 7200  
 taatgtaaat actggcaaat ctactacaaa tattatgata actacaatta ttatagtaat 7260  
 cattgtagta ttgttatcat taatagctat tgggtttactg ttgtattgta aagccaaaaa 7320  
 cacaccagtt acactaagca aagaccaact aagtgggaatc aataatattg cattcagcaa 7380  
 atagacaaaa aaccacctga tcatgtttca acaacaatct gctgaccacc aatcccaaat 7440  
 caacttaciaa caaatatttc aacatcacag tacaggctga atcatttcct cacatcatgc 7500  
 taccacata actaagctag atccttaact tatagttaca taaaaacctc aagtatcaca 7560  
 atcaaccact aaatcaacac atcattcaca aaattaacag ctggggcaaa tatgtcgcga 7620  
 agaaatcctt gtaaatttga gattagaggt cattgcttga atggtagaag atgtcactac 7680  
 agtcataatt actttgaatg gcctcctcat gcattactag tgaggcaaaa cttcatgtta 7740  
 aacaagatac tcaagtcaat ggacaaaagc atagacactt tgtctgaaat aagtggagct 7800  
 gctgaactgg atagaacaga agaatatgct cttggtatag ttggagtgtc agagagttac 7860  
 ataggatcta taaacaacat aacaaaacaa tcagcatgtg ttgctatgag taaacttctt 7920  
 attgagatca atagtgatga cattaaaaag cttagagata atgaagaacc caattcacct 7980  
 aagataagag tgtacaatac tgttatatca tacattgaga gcaatagaaa aaacaacaag 8040  
 caaaccatcc atctgtctaa gagactacca gcagacgtgc tgaagaagac aataaagaac 8100  
 acattagata tccacaaaag cataaccata agcaatccaa aagagtcaac tgtgaatgat 8160  
 caaatgacc aaacaaaaaa taatgatatt accggataaa tatccttgta gtatatcatc 8220  
 catattgatc tcaagtgaat gcattggttc tacattcaat cataaaaaa cattacaatt 8280  
 taaccataac tatttgata accaccagcg ttatttaa atcatatttg atgaaattca 8340  
 ttggacacct aaaaacttat tagatgccac tcaacaattt ctccaacatc ttaacatccc 8400  
 tgaagatata tatacagtat atatattagt gtcataatgc ttgaccataa cgactctatg 8460  
 tcatccaacc ataaaaactat tttgataagg ttatgggaca aaatggatcc cattattaat 8520  
 ggaaactctg ctaatgtgta tctaactgat agttatttaa aagggtttat ctctttttca 8580  
 gagtgtaatg ctttagggag ttatcttttt aacggccctt atcttaaaaa tgattacacc 8640  
 aacttaatta gtagacaaag cccactacta gagcatatga atcttaaaaa actaactata 8700  
 acacagtcac taatatctag atatcataaa ggtgaactga aattagaaga accaacttat 8760  
 ttccagtcac tacttatgac atataaaagt atgtcctcgt ctgaacaaat tgctacaact 8820  
 aacttactta aaaaaataat acgaagagcc atagaataaa gtgatgtaaa ggtgtacgcc 8880  
 atcttgaata aactaggatt aaaggaaaag gacagagtta agccaacaa taattcaggt 8940  
 gatgaaaact cagtacttac aaccataatt aaagatgata tactttcggc tgtggaaaac 9000  
 aatcaatcat atacaaattc agacaaaagt cactcagtaa atcaaaatat cactatcaaa 9060  
 acaacactct tgaaaaaatt gatgtgttca atgcaacatc ctccatcatg gttatacac 9120  
 tggttcaatt tatatacaaa attaaataac atattaacac aatatcgatc aaatgaggta 9180  
 aaaagtcatt ggtttatatt aatagataat caaacttta gtggttttca gtttatttta 9240  
 aatcaatatg gttgtatcgt ttatcataaa ggactcaaaa aaatcacaac tactacttac 9300  
 aatcaatatt tgacatggaa agacatcagc cttagcagat taaatgtttg ctttaattact 9360  
 tggataagta attgttttaa tacattaaac aaaagcttag ggctgagatg tggattcaat 9420  
 aatgttgtgt tatcacaatt atttctttat ggagattgta tactgaaatt atttcataat 9480  
 gaaggcttct acataataaa agaagtagag ggatttatta tgtctttaat tctaatacata 9540  
 acagaagaag atcaatttaa gaaacgattt tataatagca tgctaaataa catcacagat 9600  
 gcagctatta aggtcaaaa ggacctacta tcaagagtat gtcacacttt attagacaag 9660  
 acagtgtctg ataatatcat aaatggtaaa tggataatcc tattaagtaa atttcttaaa 9720  
 ttgattaagc ttgcagggtga taataatctc aataacttga gtgagctata ttttctcttc 9780

```

agaatctttg gacatccaat ggtcgatgaa agacaagcaa tggattctgt aagaattaac 9840
tgtaatgaaa ctaagttcta cttattaagt agtctaagta cattaagagg tgctttcatt 9900
tatagaatca taaaagggtt tgtaaatacc tacaacagat ggcccacctt aaggaaatgct 9960
attgtcctac ctctaagatg gttaaactac tataaactta atacttatcc atctctactt 10020
gaaatcacag aaaatgattt gattatttta tcaggattgc gggtctatcg tgagtttcat 10080
ctgcctaaaa aagtggatct tgaaatgata ataaatgaca aagccatttc acctccaaaa 10140
gatctaatat ggactagttt tcctagaaat tacatgccat cacatataca aaattatata 10200
gaacatgaaa agttgaagtt ctctgaaagc gacagatcga gaagagtact agagtattac 10260
ttgagagata ataaattcaa tgaatgcgat ctatacaatt gtgtagtcaa tcaaagctat 10320
ctcaacaact ctaatcacgt ggtatcacta actggtaaag aaagagagct cagtgtaggt 10380
agaatgtttg ctatgcaacc aggtatgttt aggcaaatcc aaatcttagc agagaaaatg 10440
atagctgaaa atattttaca attcttcctt gagagtttga caagatatgg tgatctagag 10500
cttcaaaaga tattagaatt aaaagcagga ataagcaaca agtcaaatcg ttataatgat 10560
aactacaaca attatatcag taaatgttct atcattacag atcttagcaa attcaatcag 10620
gcatttagat atgaaacatc atgtatctgc agtgatgtat tagatgaact gcatggagta 10680
caatctctgt tctcttggtt gcatttaaca atacctcttg tcacaataat atgtacatat 10740
agacatgcac ctcttttcat aaaggatcat gttgttaatc ttaatgaggt tgatgaacaa 10800
agtggattat acagatatca tatgggtggt attgagggtt ggtgtcaaaa actgtggacc 10860
attgaagcta tatcattatt agatctaata tctctcaaag ggaaattctc tatcacagct 10920
ctgataaatg gtgataatca gtcaattgat ataagcaaac cagttagact tatagagggt 10980
cagacccatg cacaagcaga ttatttggtt gcattaaata gccttaaat gttatataaa 11040
gagtatgcag gtataggcca taagcttaag ggaacagaga cctatatatc ccgagatatg 11100
cagttcatga gcaaaacaat ccagcacaat ggagtgtact atccagccag tatcaaaaaa 11160
gtcctgagag taggtccatg gataaacacg atacttgatg attttaaagt tagtttagaa 11220
tctataggca gcttaacaca ggagttagaa tacagaggag aaagcttatt atgcagttta 11280
atatttagga acatttggtt atacaatcaa attgctttgc aactccgaaa tcatgcatta 11340
tgtaacaata agctatattt agatatattg aaagtattaa aacacttaaa aacttttttt 11400
aatcttgata gcattgatat ggctttatca ttgtatatga atttgcctat gctgtttggt 11460
gggtggtgatc ctaatttggt atatcgaagc ttttatagga gaactccaga cttccttaca 11520
gaagctatag tacattcagt gtttgtgttg agctattata ctggtcacga tttacaagat 11580
aagctccagg atcttccaga tgatagactg aacaaattct tgacatgtgt catcacattt 11640
gataaaaaatc ccaatgccga gtttgaaca ttgatgaggg atccacaggc tttagggtct 11700
gaaaggcaag ctaaaattac tagtgagatt aatagattag cagtaacaga agtcttaagt 11760
atagcccaa acaaaatatt ttctaaaagt gcacaacatt atactaccac tgagattgat 11820
ctaaatgaca ttatgcaaaa tatagaacca acttaccctc atggattaag agttgtttat 11880
gaaagtttac ctttttataa agcagaaaaa atagttaatc ttatatcagg aacaaaatcc 11940
ataactaata tacttgaaaa aacatcagca atagatacaa ctgatattaa tagggctact 12000
gatatgatga ggaaaaatat aactttactt ataaggatac ttccactaga ttgtaacaaa 12060
gacaaaagag agttattaag tttagaaaat cttagtataa ctgaattaag caagtatgta 12120
agagaaagat cttggtcatt atccaatata gtaggagtaa catcgccaag tattatgttc 12180
acaatgaaca ttaaataatc aactagcact atagccagtg gtataataat agaaaaatat 12240
aatgttaata gtttaactcg tggtgaaaga ggaccacca agccatgggt aggtcatcc 12300
acgcaggaga aaaaaacaat gccagtgtac aacagacaag ttttaaccaa aaagcaaga 12360
gaccaaatag atttattagc aaaattagac tgggtatatg catccataga caacaaagat 12420
gaattcatgg aagaactgag tactggaaca cttggactgt catatgaaaa agccaaaaag 12480
ttgtttccac aatatctaag tgtcaattat ttacaccgtt taacagtcag tagtagacca 12540
tgtgaattcc ctgcatcaat accagcttat agaacaacaa attatcattt tgatactagt 12600
cctatcaatc atgtattaac agaaaagtat ggagatgaag atatcgacat tgtgtttcaa 12660

```

```

aattgcataa gttttggtct tagcctgatg tcggttggtg aacaattcac aaacatatgt 12720
cctaatagaa ttattctcat accgaagctg aatgagatac atttgatgaa acctcctata 12780
tttacaggag atgttgatat catcaagttg aagcaagtga tacaaaagca gcacatgttc 12840
ctaccagata aaataagttt aaccaaatat gtagaattat tcttaagtaa caaagcactt 12900
aaatctggat ctacacatcaa ctctaattta atattagtac ataaaaatgtc tgattatttt 12960
cataatgctt atattttaag tactaattta gctggacatt ggattctgat tattcaactt 13020
atgaaagatt caaaaggtat ttttgaaaaa gattggggag aggggtacat aactgatcat 13080
atgttcatta atttgaatgt tttctttaat gcttataaga cttatttgct atgttttcat 13140
aaaggttatg gtaaagcaaa attagaatgt gatatgaaca cttcagatct tctttgtgtt 13200
ttggagttaa tagacagtag ctactggaaa tctatgtcta aagttttcct agaacaaaaa 13260
gtcataaaat acatagtcaa tcaagacaca agtttgcgta gaataaaaagg ctgtcacagt 13320
tttaagttgt ggtttttaaa acgccttaat aatgctaaat ttaccgtatg cccttgggtt 13380
gttaacatag attatcaccc aacacacatg aaagctatat tatcttacat agatttagtt 13440
agaatggggt taataaatgt agataaatta accattaaaa ataaaaacaa attcaatgat 13500
gaattttaca catcaaactt cttttacatt agttataact tttcagacaa cactcatttg 13560
ctaacaaaac aaataagaat tgctaattca gaattagaag ataattataa caaactatat 13620
cacccaaccc cagaaacttt agaaaatatg tcattaattc ctgttaaaag taataatagt 13680
aacaaccta aattttgtat aagtggaaat accgaatcta tgatgatgtc aacattctct 13740
agtaaaatgc atattaaatc ttccactgtt accacaagat tcaattatag caaacaagac 13800
ttgtacaatt tatttccaat tgttgtgata gacaagatta tagatcatte aggtaatata 13860
gcaaaatcta accaacttta caccaccact tcacatcaga catctttagt aaggtaatag 13920
gcatcacttt attgcatgct tccttggcat catgtcaata gatttaactt tgtatttagt 13980
tccacaggat gcaagatcag tatagagtat attttaaaag atcttaagat taaggacccc 14040
agttgtatag cattcatagg tgaaggagct ggtaacttat tattacgtac ggtagtagaa 14100
cttcatccag acataagata catttacaga agtttaaaag attgcaatga tcatagttta 14160
cctattgaat ttctaagggt atacaacggg catataaaca tagattatgg tgagaattta 14220
accattcctg ctacagatgc aactaataac attcattgggt cttatttaca tataaaattt 14280
gcagaacctt ttagcatctt tgtctgcgat gctgaattac ctgttacagc caattggagt 14340
aaaattataa ttgaatggag taagcatgta agaaagtgca agtactgttc ttctgtaat 14400
agatgcattt taattgcaaa atatcatgct caagatgaca ttgatttcaa attagataac 14460
attactatat taaaaactta cgtgtgccta ggtagcaagt taaaaggatc tgaagtttac 14520
ttaatcctta caataggccc tgcaaatata ctctctgttt ttgatgttgt acaaaatgct 14580
aaattgatac tttcaagaac taaaaatttc attatgccta aaaaaactga caaggaatct 14640
atcgatgcaa atattaaaag cttaatacct tcctttgtt accctataac aaaaaagga 14700
attaagactt cattgtcaaa attgaagagt gtagttaatg gagatatatt atcatattct 14760
atagctggac gtaatgaagt attcagcaac aagcttataa accacaagca tatgaatata 14820
ctaaaatggc tagatcatgt tttaaathtt agatcagctg aacttaatta caatcattta 14880
tacatgatag agtccacata tccttactta agtgaattgt taaatagttt aacaaccaat 14940
gagctcaaga agctgattaa aataacagggt agtgtgctat acaaccttcc caacgaacag 15000
tagtttaaaa tatcattaac aagtttggtc aaatttagat gctaacacat cattatatta 15060
tagttattaa agaataataa aacttttcaa taatttagca tattgattcc aaaattatca 15120
ttttagtctt aaggggttaa ataaaagtct aaaactaaca attatacatg tgcattcaca 15180
acacaacgag acattagttt ttgacacttt ttttctcgt 15219

```

&lt;210&gt; 14

&lt;211&gt; 15219

&lt;212&gt; DNA

&lt;213&gt; respiratory syncytial virus

&lt;400&gt; 14

```

acgggaaaaa aatgcgtact acaaacttgc acattcgaaa aaaatggggc aaataagaac 60
ttgataagtg ctattttaagt ctaacctttt caatcagaaa tggggtgcaa ttcactgagc 120
atgataaagg ttagattaca aaattttatt gacaatgacg aagtagcatt gttaaaaata 180
acatgtttata ctgataaatt aattcttctg accaatgcat tagccaaagc agcaatacat 240
acaattaaat taaacggcat agtttttata catgtttata caagcagtga agtgtgccct 300
gataacaata ttgtagtga atctaaactt acaacaatgc caatactaca aaatggagga 360
tacatatggg aattgattga gttgacacac tgctctcaat taaacggttt aatggatgat 420
aattgtgaaa tcaaattttc taaaagacta agtgactcag taatgactaa ttatatgaat 480
caaatatctg acttacttgg gcttgatctc aattcatgaa ttatgtttag tctaattcaa 540
tagacatgtg tttattacca ttttagttaa tataaaaact catcaaaggg aaatggggca 600
aataaactca cctaatacat caaacatga gcactacaaa tgacaacact actatgcaaa 660
gattgatgat cacagacatg agaccctgt caatggattc aataataaca tctcttacca 720
aagaaatcat cacacacaaa ttcataact tgataaaca tgaatgtatt gtaagaaaac 780
ttgatgaaag acaagctaca tttacattct tagtcaatta tgagatgaag ctactgcaca 840
aagtagggag taccaaatac aaaaaataca ctgaatataa taaaaatat ggcactttcc 900
ccatgcctat atttatcaat cacggcgggt ttctagaatg tattggcatt aagcctacaa 960
aacacactcc tataatatac aaatatgacc tcaaccctg aattccaaca aaaaaaccaa 1020
cccaaccaa ccaaactatt cctcaaaca cagtgtcaa tagttaagaa ggagctaata 1080
catttttagt attaaaaata aaagtaaagc caataacata aattggggca aatacaaga 1140
tggtcttag caaagtcaag ttgaatgata cattaaataa ggatcagctg ctgtcatcca 1200
gcaaatacac tattcaacgt agtacaggag ataatttga cactccaat tatgatgtgc 1260
aaaaacacct aaacaaacta tgtggtatgc tattaatcac tgaagatgca aatcataaat 1320
tcacaggatt aataggatat ttatatgcta tgtccagggt aggaaggga gacactataa 1380
agatacttaa agatgctgga tatcatgtta aagctaattg agtagatata acaacatata 1440
gtcaagatat aaatggaaag gaaatgaaat tcgaagtatt aacattatca agcttgacat 1500
cagaaataca agtcaatatt gagatagaat ctagaaagtc ctacaaaaaa atgctaaaag 1560
agatgggaga agtggctcca gaatataggc atgattctcc agactgtggg atgataatac 1620
tgtgtatagc tgcaactgtg ataaccaaat tagcagcagg agacagatca ggtcttacag 1680
cagtaattag gagggcaaac aatgtcttaa aaaacgaaat aaaacgatac aagggcctca 1740
taccaaagga tatagctaac agtttttatg aagtgtttga aaaacacct catcttatag 1800
atgttttctg gcactttggc attgcacaat catccacaag agggggtagt agagttgaag 1860
gaatctttgc aggattgttt atgaatgcct atggttcagg gcaagtaatg ctaagatggg 1920
gagtttttagc caaatctgta aaaaatatca tgctaggaca tgctagtgtc caggcagaaa 1980
tggagcaagt tgtggaagtc tatgagtatg cacagaagtt gggaggagaa gctggattct 2040
accatatatt gaacaatcca aaagcatcat tgctgtcatt aactcaattt cccaacttct 2100
caagtgtggt cctaggcaat gcagcaggtc taggcataat gggagagtat agaggtacac 2160
caagaaacca ggatctttat gatgcagcta aagcatatgc agagcaactc aaagaaaatg 2220
gagtaataaa ctacagtgtg ttagacttaa cagcagaaga attggaagcc ataaagcatc 2280
aactcaacc caaaagaagat gatgtagagc tttaagttaa caaaaaatac ggggcaaata 2340
agtcaacatg gagaagttg cacctgaatt tcatggagaa gatgcaaata acaaagctac 2400
caaatctcta gaatcaataa agggcaagtt cgcacatcc aaagatccta agaagaaaag 2460
tagcataata tctgttaact caatagatat agaagtaact aaagagagcc cgataacatc 2520
tggcaccaac atcatcaatc caacaagtga agccgacagt accccagaaa caaaagccaa 2580
ctacccaaga aaacccttag taagcttcaa agaagatctc accccaagtg acaacccttt 2640
ttctaagttg tacaaggaaa caatagaaac atttgataac aatgaagaag aatctagcta 2700
ctcatatgaa gagataaatg atcaacaaaa tgacaacatt acagcaagac tagatagaat 2760

```

tgatgaaaaa ttaagtgaat tattaggaat gctccatata ttagtagttg caagtgcagg 2820  
 acccacttca gctcgcgatg gaataagaga tgctatggtt ggtctaagag aagagatgat 2880  
 agaaaaata agagcggaag cattaatgac caatgatagg ttagaggcta tggcaagact 2940  
 taggaatgag gaaagcgaaa aaatggcaaa agacacctca gatgaagtgt ctcttaatcc 3000  
 aacttccaaa aaattgagtg acttggttga agacaacgat agtgacaatg atctatcact 3060  
 tgatgatatt tgatcagcga tcaactcact cagcaatcaa caacatcaat aaaacagaca 3120  
 tcaatccatt gaatcaactg ccagaccgaa caaacaacag tccatcagta gaaccaccaa 3180  
 ccaatcaatc aaccaattga tcaatcagca acccgacaaa attaacaata tagtaacaaa 3240  
 aaaagaacaa gatggggcaa atatggaaac atacgtgaac aagcttcacg aaggctccac 3300  
 atacacagca gctgttcagt acaatgttct agaaaaagat gatgatcctg catcactaac 3360  
 aatatgggtg cctatgttcc agtcatctgt gccagcagac ttgctcataa aagaacttgc 3420  
 aagcatcaat atactagtga agcagatctc tacgcccacaa ggaccttcac tacgagtcac 3480  
 gattaactca agaagtgtg tgctggctca aatgcctagt aatttcacat taagcgcaaa 3540  
 tgtatcatta gatgaaagaa gcaaattagc atatgatgta actacacctt gtgaaatcaa 3600  
 agcatgcagt ctaacatgct taaaagtaaa aagtatgtta actacagtca aagatcttac 3660  
 catgaagaca ttcaacccca ctcatgagat cattgtctca tgtgaatttg aaaatattat 3720  
 gacatcaaaa agagtaataa taccaacctc tctaagatca attagtgtca agaacaagga 3780  
 tctgaactca ctagaaaata tagcaaccac cgaattcaaa aatgctatca ccaatgcaaa 3840  
 aattattcct tatgcaggat tagtgtagt tatcacagtt actgacaata aaggagcatt 3900  
 caaatatata aaaccacaga gtcaatttat agtagatctt ggtgcctacc tagaaaaaga 3960  
 gagcatatat tatgtgacta ctaattggaa gcatacagct acacgttttt caatcaaac 4020  
 actagaggat taaacttaat tatcaacact gaatgacagg tccacatata tcttcaaac 4080  
 acacactata tccaaacatc ataaacatct acactacaca cttcatcaca caaaccaatc 4140  
 ccactcaaaa tccaaatca ctaccagcca ctatctgcta gacctagagt gcgaataggt 4200  
 aaataaaacc aaaatatggg gtaaatagac attagttaga gttcaatcaa tcttaacaac 4260  
 catttatacc gccaatcaa cacatatact ataaatctta aaatgggaaa tacatccatc 4320  
 acaatagaat tcacaagcaa attttggccc tattttacac taatacatat gatcttaact 4380  
 ctaatctttt tactaattat aatcactatt atgattgcaa tactaaataa gctaagtga 4440  
 cataaagcat tctgtaacaa aactcttgaa ctaggacaga tgtatcaaat caacacatag 4500  
 agttctacca ttatgtgtg tcaattata atcctgtata tataaacaaa caaatccaat 4560  
 cttctcacag agtcatggtg tcgcaaaacc acgctaacta tcatggtagc atagagtagt 4620  
 tatttaaaaa ttaacataat gatgaattgt tagtatgaga tcaaaaacaa cattggggca 4680  
 aatgcaacca tgtccaaaca caagaatcaa cgcactgcca ggactctaga aaagacctgg 4740  
 gatactctta atcatcta atgtaatatcc tcttgtttat acagattaaa tttaaaatct 4800  
 atagcacaaa tagcactatc agttttggca atgataatct caacctctct cataattgca 4860  
 gccataatat tcatcatctc tgccaatcac aaagttacac taacaacggt cacagttcaa 4920  
 acaataaaaa accacactga aaaaaacatc accacctacc ctactcaagt ctcaccagaa 4980  
 agggtaggtt catccaagca acccacaacc acatcaccaa tccacacaag ttcagctaca 5040  
 acatcaccca atacaaaatc agaaacacac catacaacag cacaacacaa aggcagaacc 5100  
 accacttcaa cacagaccaa caagccaagc acaaaaccac gtccaaaaaa tccacaaaaa 5160  
 aaagatgatt accattttga agtggttaac ttctgtccct gcagtatatg tggcaacaat 5220  
 caactttgca aatccatctg caaaacaata ccaagcaaca aaccaaagaa gaaaccaacc 5280  
 atcaaaccca caaacaaccc aaccacaaaa accacaaaca aaagagaccc aaaaacacca 5340  
 gccaaaacga cgaaaaaaga aactaccacc aaccacaaca aaaaactaac cctcaagacc 5400  
 acagaaagag acaccagcac ctcacaatcc actgcactcg acacaaccac attaaaacac 5460  
 acagtccaac agcaatccct cctctcaacc acccccgaac acacacccaa ctccacacaa 5520  
 acaccacag catccgagcc ctccacacca aactccaccc aaaaaaccca gccacatgct 5580  
 tagttattca aaaactacat ctagcagag aaccgtgatc tatcaagcaa gaacgaaatt 5640

```

aaacctggggg caaataacca tggagttgat gatccacaag tcaagtgcaa tcttcctaac 5700
tcttgctatt aatgcattgt acctcacctc aagtcagaac ataactgagg agttttacca 5760
atcgacatgt agtgcagtta gcagagggtta ttttagtgct ttaagaacag gttggtatac 5820
tagtgtcata acaatagaat taagtaatat aaaagaaacc aatgcaatg gaactgacac 5880
taaagtaaaa cttatgaaac agaattaga taagtataag aatgcagtaa cagaattaca 5940
gctactttatg caaaacacac cagctgtcaa caaccgggcc agaagagaag caccacagta 6000
tatgaactac acaatcaata ccactaaaaa cctaaatgta tcaataagca agaagaggaa 6060
acgaagattt ctaggcttct tgttaggtgt gggatctgca atagcaagt gtatagctgt 6120
atcaaaagtt ctacaccttg aaggagaagt gaacaagatc aaaaatgctt tgttgtctac 6180
aaacaaagct gtagtcagtt tatcaaattg ggtcagtggt ttaaccagca aagtgttaga 6240
tctcaagaat tacataaata accaattatt acctatagta aatcaacaga gctgtcgcat 6300
ctccaacatt gaaacagtta tagaattcca gcagaagaac agcagattgt tggaaatcac 6360
cagagaattt agtgtcaatg caggtgtaac aacaccttta agcacttaca tgttgacaaa 6420
cagtgcagtt ctatcattaa tcaatgatat gcctataaca aatgatcaga aaaaattaat 6480
gtcaagcaat gttcagatag taaggcaaca aagttattcc atcatgtcta taataaagga 6540
agaagtccct gcatatgttg tacagctgcc tatctatggg gtaatagata caccttgctg 6600
gaaattgcac acatgcctc tatgcactac caacatcaa gaaggatcaa atatttgttt 6660
aacaaggact gatagaggat ggtattgtga taatgcagga tcagtatcct tctttccaca 6720
ggctgcact tgtaaagtac agtccaatcg agtatttgt gacactatga acagtttgac 6780
attaccaagt gaagtcagcc ttgtaacac tgacatattc aattccaagt atgactgcaa 6840
aattatgaca tcaaaaacag acataagcag ctcagtaatt acttctcttg gagctatagt 6900
gtcatgctat ggtaaaacta aatgcactgc atccaacaaa aatcgtggga ttataaagac 6960
attttcta at ggtgtgact atgtgtcaaa caaaggagta gatactgtgt cagtgggcaa 7020
cactttatac tatgtaaaca agctggaagg caagaacctt tatgtaaaag gggaacctat 7080
aataaattac tatgacctc tagtgtttcc ttctgatgag ttgatgcat caatatctca 7140
agtcaatgaa aaaatcaatc aaagtttagc ttttattcgt agatctgatg aattactaca 7200
taatgtaaat actggcaaat ctactacaaa tattatgata actacaatta ttatagtaat 7260
cattgtagta ttgttatcat taatagctat tggtttactg ttgtattgta aagccaaaaa 7320
cacaccagtt aactaagca aagaccaact aagtggatc aataatattg cattcagcaa 7380
atagacaaaa aaccacctga tcatgtttca acaacaatct gctgaccacc aatcccaaat 7440
caacttacaa caaatatttc aacatcacag tacaggctga atcatttctt cactatcatg 7500
taccacata actaagctag atccttaact tatagttaca taaaacctc aagtatcaca 7560
atcaaccact aatcaacac atcattcaca aaattaacag ctggggcaaa tatgtcgcga 7620
agaaatcctt gtaaatttga gattagaggt cattgcttga atggtagaag atgtcactac 7680
agtcataatt actttgaatg gcctcctcat gcattactag tgaggcaaaa ctatcatgta 7740
aacaagatac tcaagtcaat ggacaaaagc atagacactt tgtctgaaat aagtggagct 7800
gctgaactgg atagaacaga agaatatgct cttggtatag ttggagtgt agagagttac 7860
ataggatcta taaacaacat aacaaaacaa tcagcatgtg ttgctatgag taaacttctt 7920
attgagatca atagtgatga cattaaaaag cttagagata atgaagaacc caattcacct 7980
aagataagag tgtacaatac tgttatatca tacattgaga gcaatagaaa aaacaacaag 8040
caaaccatcc atctgctcaa gagactacca gcagacgtgc tgaagaagac aataaagaac 8100
acattagata tccacaaaag cataaccata agcaatccaa aagagtcaac tgtgaatgat 8160
caaatgacc aaacaaaaa taatgatatt accggataaa tatccttgta gtatatcatc 8220
catattgatc tcaagtgaat gcatggttgc tacattcaat cataaaaaa tattacaatt 8280
taaccataac tatttgata accaccagcg tttattaaat catatatttg atgaaattca 8340
ttggacacct aaaaacttat tagatgccac tcaacaattt ctccaacatc ttaacatccc 8400
tgaagatata tatacagtat atatattagt gtcataatgc ttgaccataa cgactctatg 8460
tcatccaacc ataaaactat tttgataagg ttatgggaca aaatggatcc cattattaat 8520

```

```

ggaaactctg ctaatgtgta tctaactgat agttattttaa aagggtgttat ctcttttttca 8580
gagtgtaatg ctttagggag ttatctttttt aacggccctt atcttaaaaa tgattacacc 8640
aacttaatta gtagacaaaag cccactacta gagcatatga atcttaaaaa actaactata 8700
acacagtcac taatatctag atatcataaa ggtgaactga aattagaaga accaacttat 8760
ttccagtcac tacttatgac atataaaagt atgtcctcgt ctgaacaaat tgctacaact 8820
aacttactta aaaaaataat acgaagagcc atagaaataa gtgatgtaaa ggtgtacgcc 8880
atcttgaata aactaggatt aaaggaaaag gacagagtta agcccaacaa taattcaggt 8940
gatgaaaact cagtacttac aactataatt aaagatgata tactttcggc tgtggaaaac 9000
aatcaatcat atacaaattc agacaaaagt cactcagtaa atcaaaatat cactatcaaa 9060
acaacactct tgaaaaaatt gatgtgttca atgcaacatc ctccatcatg gttaatacac 9120
tggttcaatt tatatacaaa attaaataac atattaacac aatatcgatc aaatgaggta 9180
aaaagtcacg ggttttatatt aatagataat caaactttta gtggttttca gtttatttta 9240
aatcaatatg gttgtatcgt ttatcataaa ggactcaaaa aaatcacac tactacttac 9300
aatcaatttt tgacatggaa agacatcagc cttagcagat taaatgtttg cttaattact 9360
tggataagta attgttttaa tacattaaac aaaagcttag ggctgagatg tggattcaat 9420
aatgttgtgt tatcacaatt atttctttat ggagattgta tactgaaatt atttcataat 9480
gaaggcttct acataataaa agaagtagag ggattttatta tgtctttaat tctaaacata 9540
acagaagaag atcaatttag gaaacgattt tataatagca tgctaaataa catcacagat 9600
gcagctatta aggtcaaaa ggacctacta tcaagagtat gtcacacttt attagacaag 9660
acagtgtctg ataatatcat aaatggtaaa tggataatcc tattaagtaa atttctttaa 9720
ttgattaagc ttgcagggtg taataatctc aataacttga gtgagctata ttttctcttc 9780
agaatctttg gacatccaat ggtcgatgaa agacaagcaa tggattctgt aagaattaac 9840
tgtaatgaaa ctaagttcta cttattaagt agtctaagta cattaagagg tgctttcatt 9900
tatagaatca taaaagggtt tgtaaatacc tacaacagat ggcccacctt aaggaatgct 9960
attgtcctac ctctaagatg gttaaactac tataaactta atacttatcc atctctactt 10020
gaaatcacag aaaatgattt gattatttta tcaggattgc ggttctatcg tgagtttcat 10080
ctgcctaaaa aagtggatct tgaaatgata ataaatgaca aagccatttc acctccaaaa 10140
gatctaatat ggactagttt tcctagaaat tacatgccat cacatataca aaattatata 10200
gaacatgaaa agttgaagtt ctctgaaagc gacagatcga gaagagtact agagtattac 10260
ttgagagata ataaattcaa tgaatgcgat ctatacaatt gtgtagtcaa tcaaagctat 10320
ctcaacaact ctaatcacgt ggtatcacta actggtaaag aaagagagct cagtgtaggt 10380
agaatgtttg ctatgcaacc aggtatgttt aggcaaatcc aaatcttagc agagaaaatg 10440
atagctgaaa atattttaca attcttccct gagagtttga caagatatgg tgatctagag 10500
cttcaaaaga tattagaatt aaaagcagga ataagcaaca agtcaaactg ttataatgat 10560
aactacaaca attatatcag taaatgttct atcattacag atcttagcaa attcaatcag 10620
gcatttagat atgaaacatc atgtatctgc agtgatgtat tagatgaact gcatggagta 10680
caatctctgt tctcttggtt gcatttaaca atacctcttg tcacaataat atgtacatat 10740
agacatgcac ctcttttcat aaaggatcat gttgttaatc ttaatgaggt tgatgaacaa 10800
agtggattat acagatatca tatgggtggt attgagggct ggtgtcaaaa actgtggacc 10860
attgaagcta tatcattatt agatctaata tctctcaaa ggaaattctc tatcacagct 10920
ctgataaatg gtgataatca gtcaattgat ataagcaaac cagtttagact tatagagggg 10980
cagacccatg cacaagcaga ttatttggtt gcattaaata gccttaaat gttatataaa 11040
gagtatgcag gtataggcca taagcttaag ggaacagaga cctatatatc ccgagatatg 11100
cagttcatga gcaaaacaat ccagcacaat ggagtgtact atccagccag tatcaaaaaa 11160
gtcctgagag taggtccatg gataaacacg atacttgatg attttaaagt tagtttagaa 11220
tctataggca gcttaacaca ggagttagaa tacagaggag aaagcttatt atgcagttta 11280
atatttagga acatttggtt atacaatcaa attgctttgc aactccgaaa tcatgcatta 11340
tgtaacaata agctatatatt agatatattg aaagtattaa aacacttaaa aacttttttt 11400

```

```

aatcttgata gcattgatat ggctttatca ttgtatatga atttgcctat gctgtttggt 11460
gggtggtgatc ctaatttggt atatogaagc ttttatagga gaactccaga cttccttaca 11520
gaagctatag tacattcagt gtttgtgttg agctattata ctggtcacga ttacaagat 11580
aagctccagg atcttcaga tgatagactg aacaaattct tgacatgtgt catcacattt 11640
gataaaaatc ccaatgccga gtttgaaca ttgatgaggg atccacaggc tttagggtct 11700
gaaaggcaag ctaaaattac tagtgagatt aatagattag cagtaacaga agtcttaagt 11760
atagcccaa acaaaatatt ttctaaaagt gcacaacatt atactaccac tgagattgat 11820
ctaatgaca ttatgcaaaa tatagaacca acttaccctc atggattaag agttgtttat 11880
gaaagtttac ctttttataa agcagaaaaa atagttaate ttatatcagg aacaaaatcc 11940
ataactaata tacttgaaaa aacatcagca atagatacaa ctgatattaa tagggctact 12000
gatatgatga ggaaaaatat aactttactt ataaggatac ttccactaga ttgtaacaaa 12060
gacaaaagag agttattaag tttagaaaat cttagtataa ctgaattaag caagtatgta 12120
agagaaagat cttgggtcatt atccaatata gtaggagtaa catcgccaag tattatgttc 12180
acaatggaca ttaaataatc aactagcact atagccagtg gtataataat agaaaaatat 12240
aatgttaata gtttaactcg tggtgaaaga ggacccacca agccatgggt aggtcatcc 12300
acgcaggaga aaaaaacaat gccagtgtac aacagacaag ttttaaccaa aaagcaaga 12360
gaccaaatag atttattagc aaaattagac tgggtatatg catccataga caacaaagat 12420
gaattcatgg aagaactgag tactggaaca cttggactgt catatgaaaa agccaaaaag 12480
ttgtttccac aatatctaag tgtcaattat ttacaccgtt taacagtcag tagtagacca 12540
tgtgaattcc ctgcatcaat accagcttat agaacaacaa attatcattt tgatactagt 12600
cctatcaatc atgtattaac agaaaagtat ggagatgaag atatcgacat tgtgtttcaa 12660
aattgcataa gttttggtct tagcctgatg tcggttgtgg aacaattcac aaacatatgt 12720
cctaatagaa ttattctcat accgaagctg aatgagatac atttgatgaa acctctata 12780
tttacaggag atgttgatat catcaagttg aagcaagtga tacaaaagca gcacatgttc 12840
ctaccagata aaataagttt aaccaatat gtagaattat tcttaagtaa caaagcactt 12900
aaatctggat ctcacatcaa ctctaattta atattagtac ataaaatgtc tgattatttt 12960
cataatgctt atattttaag tactaattta gctggacatt ggattctgat tattcaactt 13020
atgaaagatt caaaaggat ttttgaaaaa gattggggag aggggtacat aactgatcat 13080
atgttcatta atttgaatgt tttctttaat gcttataaga cttatttgct atgttttcat 13140
aaaggttatg gtaaagcaaa attagaatgt gatatgaaca cttcagatct tctttgtgtt 13200
ttggagttaa tagacagtag ctactggaat tctatgtcta aagttttcct agaacaaaaa 13260
gtcataaaat acatagtcaa tcaagacaca agtttgcgta gaataaaagg ctgtcacagt 13320
tttaagttgt ggtttttaaa acgccttgat aatgctaaat ttaccgtatg cccttgggtt 13380
gttaacatag attatcacc ccaacacatg aaagctatat tatcttacat agatttagtt 13440
agaatggggt taataaatgt agataaatta accattaaaa ataaaaacaa attcaatgat 13500
gaattttaca catcaaactt cttttacatt agttataact tttcagacaa cactcatttg 13560
ctaacaaaac aaataagaat tgctaattca gaattagaag ataattataa caaactatat 13620
caccacaacc cagaaacttt agaaaatatg tcattaattc ctgttaaaag taataatagt 13680
aacaaaccta aattttgat aagtggaaat accgaatcta tgatgatgtc aacattctct 13740
agtaaaatgc atattaaatc ttccactgtt accacaagat tcaattatag caaacaagac 13800
ttgtacaatt tatttccaat tgttgtgata gacaagatta tagatcattc aggtaataca 13860
gcaaaatcta accaacttta caccaccact tcacatcaga catctttagt aaggaaatag 13920
gcatcacttt attgcatgct tccttggcat catgtcaata gatttaactt tgtatttagt 13980
tccacaggat gcaagatcag tatagagtat attttaaaag atcttaagat taaggacccc 14040
agttgtatag cattcatagg tgaaggagct ggtaacttat tattacgtac ggtagtagaa 14100
cttcatccag acataagata catttacaga agtttaaaag attgcaatga tcatagttta 14160
cctattgaat ttctaagggt atacaacggg catataaaca tagattatgg tgagaattta 14220
accattcctg ctacagatgc aactaataac attcattggt cttatttaca tataaaattt 14280

```



```

gcagaacctta ttagcatcctt tgtctgcat gctgaattac ctgttacagc caattggagt 14340
aaaattataa ttgaatggag taagcatgta agaaagtgca agtactgttc ttctgtaaatt 14400
agatgcattt taattgcaaa atatcatgct caagatgaca ttgatttcaa attagataac 14460
attactatat taaaaactta cgtgtgccta ggtagcaagt taaaaggatc tgaagtttac 14520
ttaatcctta caataggccc tgcaaatata cttcctgttt ttgatgttgt acaaaatgct 14580
aaattgatac tttcaagaac taaaaatttc attatgccta aaaaaactga caaggaatct 14640
atcgatgcag ttattaaaag cttaatacct ttcctttgtt accctataac aaaaaaagga 14700
attaagactt cattgtcaaa attgaagagt gtagttaatg gagatatatt atcatattct 14760
atagctggac gtaatgaagt attcagcaac aagcttataa accacaagca tatgaatatt 14820
ctaaaatggc tagatcatgt tttaaatttt agatcagctg aacttaatta caatcattta 14880
tacaatgatag agtccacata tccttactta agtgaattgt taaatagttt aacaaccaat 14940
gagctcaaga agctgattaa aataacaggt agtgtgctat acaaccttcc caacgaacag 15000
tagtttaaaa tatcattaac aagtttggtc aaatttagat gctaacacat cattatatta 15060
tagttattaa aaaatatata aacttttcaa taatttagca tattgattcc aaaattatca 15120
ttttagtctt aaggggttaa ataaaagtct aaaactaaca attatacatg tgcattcaca 15180
acacaacgag acattagttt ttgacacttt ttttctcgt 15219

```

&lt;210&gt; 15

&lt;211&gt; 24

&lt;212&gt; DNA

&lt;213&gt; Measles virus

&lt;400&gt; 15

catatcactc actctgggat ggag

24

&lt;210&gt; 16

&lt;211&gt; 20

&lt;212&gt; DNA

&lt;213&gt; Measles virus

&lt;400&gt; 16

tcagaacatc aagcaccgcc

20

&lt;210&gt; 17

&lt;211&gt; 20

&lt;212&gt; DNA

&lt;213&gt; Measles virus

&lt;400&gt; 17

acagtcaaga ctgagatgag

20

&lt;210&gt; 18

&lt;211&gt; 20

&lt;212&gt; DNA

&lt;213&gt; Measles virus

&lt;400&gt; 18

aagagtcaga tacatgtgga

20

<210> 19  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 19  
acatgaatca gcctaaagtc

20

<210> 20  
<211> 25  
<212> DNA  
<213> Measles virus

<400> 20  
ccgaaagagt tcctgcgtta cgacc

25

<210> 21  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 21  
cagtcacac aagtaccagg

20

<210> 22  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 22  
gtcagaagct gtggaccatc

20

<210> 23  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 23  
aatattgcta caacaatggc

20

<210> 24  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 24  
actcttcatt cctagactgg

20

<210> 25  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 25  
gtccaattat gactatgaac

20

<210> 26  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 26  
agaacagaca tgaagcttgc

20

<210> 27  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 27  
ccaacaagga atgcttctag

20

<210> 28  
<211> 25  
<212> DNA  
<213> Measles virus

<400> 28  
acagcactat ctatgattga cctgg

25

<210> 29  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 29  
gcaacatggg ttacacatgc

20

<210> 30  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 30  
agattgagag ttgatccagg

20

<210> 31  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 31  
aggagatact taaactaagc 20

<210> 32  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 32  
taagcttatg cctttcagcg 20

<210> 33  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 33  
ttaacggacc taagctgtgc 20

<210> 34  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 34  
gaaacagatt attatgacgg 20

<210> 35  
<211> 24  
<212> DNA  
<213> Measles virus

<400> 35  
cgggctatct aggtgaactt cagg 24

<210> 36  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 36  
atttgatat ggaatatgag 20

<210> 37  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 37  
actcaactga actaccagtg 20

<210> 38  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 38  
aagaacatca tgtatttcag 20

<210> 39  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 39  
ttatcaacgc actgctcatg 20

<210> 40  
<211> 25  
<212> DNA  
<213> Measles virus

<400> 40  
attttcagca atcacttggc atgcc 25

<210> 41  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 41  
gcctctgtgc aaacaagctg 20

<210> 42  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 42  
tctctagtta ctctagcagc 20

<210> 43  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 43  
aggtcggtgt ttgtgaggag 20

<210> 44  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 44  
tcgtcctctt ctttactgtc 20

<210> 45  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 45  
ccgtcctcga gctagcctcg 20

<210> 46  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 46  
ctcctccagg ctcacattgg 20

<210> 47  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 47  
gggttggtac atagctctgc 20

<210> 48  
<211> 25  
<212> DNA  
<213> Measles virus

<400> 48  
cacccatctg atatttcct gatgg 25

<210> 49  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 49  
tggttgacag taaaaatctg 20

<210> 50  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 50  
ctgaaatggg aagattgtgc 20

<210> 51  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 51  
agcaatctac actgcctacc 20

<210> 52  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 52  
tcacagatga ttcaattatc 20

<210> 53  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 53  
gatcctagat ataagttctc 20

<210> 54  
<211> 21  
<212> DNA  
<213> Measles virus

<400> 54  
accaaacaaa gttgggtaag g 21

<210> 55  
<211> 32  
<212> DNA  
<213> Measles virus

<400> 55  
gggggatcca tccctaatacc tgctcttgtc cc 32

<210> 56  
<211> 20  
<212> DNA  
<213> Measles virus

<400> 56  
gattcctctg atggctccac 20

<210> 57  
<211> 21  
<212> DNA  
<213> Measles virus

<400> 57  
taacagtcaa ggagacaaa g 21

<210> 58  
<211> 32  
<212> DNA  
<213> Measles virus

<400> 58  
gggaagctta accctaatacc tgccttaggt gg 32

<210> 59  
<211> 22  
<212> DNA  
<213> Measles virus

<400> 59  
accagacaaa gctgggaata ga 22